
eFinger™ - Button

eKT2101

**Capacitive Touch Sensor
Controller**

Product Specification

Doc. VERSION 1.9

ELAN MICROELECTRONICS CORP.


August 2008



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1.9	<ol style="list-style-type: none">1. Modify some error description and drawing2. Add "IOmode debug"3. Add "Parameter update"	2008/07/23



1 Introduction

The eKT2101 is low-cost single chip solution for capacitive touchpad. It is 8-bit RISC architecture microcontroller devices with Serial Peripheral Interface (SPI-Slave), I2C-slave (Normal Mode).

For function application, the eKT2101 support Button information for customers. In operation mode, eKT2101 can support Protocol and I/O mode for customer. Developer can use I/O mode to get a valid button message and develop their system very easily, and no longer need to decode the communication package.

The capacitive touchpad sensor is covered with a plastic or glass case. It provides auto-calibrate the parameter for a wide range of capacitance on the touchpad sensor (5pF~35pF). The system controller converts finger data to button presses, depending on finger location and human interface context.

The eKT2101 supports multi-package for various application. Package types are QFP(32 pin) and SOP(28/24/16 pin).

2 Features

- Operating voltage : 3V~5.5V,
Ripple < 300mVpp
- Power-on reset time : Stable time for operating < 350ms, the touchpad will send "Packet Hello" after initialization
- Interface features : Serial Peripheral Interface (SPI Slave) and I2C-slave (Normal Mode)
- Operating mode: (@ 5V)
- Useful information
- Sensitivity: sensitivity can be adjusted from 00H to 0FH for different thickness of the plastic or glass cover. The default label is "07H".
- Package type:

Mode	Description	Current
Normal	1. Finger on touchpad	<4.2 mA
	2. Higher scan rate	
Idle	1. Finger leaves touchpad	<150 μ A
	2. Lower scan rate	
Sleep	No scanning	<2 μ A

32-pin QFN 5x5	:	eKT2101QN32J
28-pin SOP 300mil	:	eKT2101SO28J
24-pin SOP 300mil	:	eKT2101SO24J
16-pin SOP 150mil	:	eKT2101SO16AJ

- Features Comparison Table:

Part No.	Operating Voltage	Button Mode (Step)	SPI_Slave	I ² C_Slave	IO mode (Direct Key)	Package Type
eKT2101 QN32J	3V~5.5V	18 buttons (Button mode) 9 buttons (Direct key mode)	✓	✓	✓	QFN32(5x5)
eKT2101 SO28J	3V~5.5V	18 buttons (Button mode) 9 buttons (Direct key mode)	✓	✓	✓	SOP28
eKT2101 SO24J	3V~5.5V	14 buttons (Button mode) 7 buttons (Direct key mode)	✓	✓	✓	SOP24
eKT2101 SO16AJ	3V~5.5V	6 buttons (Button mode) 3 buttons (Direct keymode)	✓	✓	✓	SOP16

Legend: "✓" = function is available if enabled

3 Three-Mode State Transition

The eKT2101 touch pad controller provides Normal, IDLE and SLEEP mode. In eKT2101 system power on reset, original definition of system operate on normal mode. If power saving time is set to 0, and TPpsB signal is set to 1, eKT2101 always stays on normal mode.

If power saving time is not set to 0, but TPpsB signal is set to 1, operation mode will be enter IDLE mode from normal mode. When fingers touch touchpad, system will return normal mode and execute touch pad function until fingers leave. At this time, system will return automatically from idle mode. This mode provides the best touch pad function and saving electricity solution. The efficiency of saving electricity is depended on the setting of power saving time.

When eKT2101 operate on normal mode or idle mode, eKT2101 will stop touch pad function, and in to sleep mode as long as TPpsB signal is set to 0, until TPpsB is set to 1. At this time, eKT2101 will return to normal mode. This mode provides about low power of 2uA.

The eKT2101 operation mode transition shows the below:

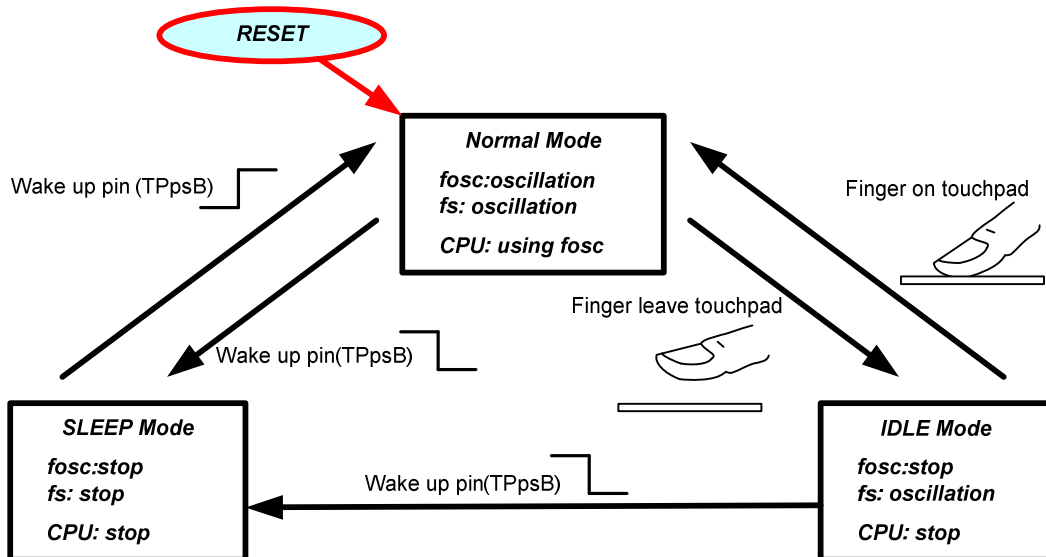


Figure 3-1-1 CPU Mode Status

4 Interface Description

4.1 SPI Slave Interface

The Serial Peripheral Interface (SPI) is a 3-wire serial communications interface used by many microprocessor peripheral chips. It consists of two data pins (SDI, SDO) and a clock pin (SCK) and always transfers data in 8-bit blocks. The touchpad controller only provides SPI slave communication with host. Touchpad controller SPI communication protocol is defined to Falling edge Data Output (SDO), Rising edge Data Input (SDI). The waveform is as Figure 4-1-1:

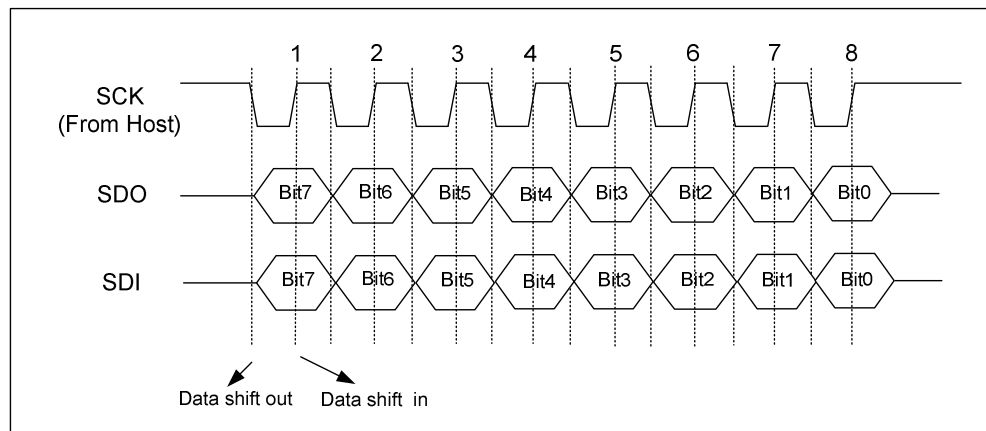


Figure 4-1-1 SPI communication timing

For SPI slave mode selection, the SPI interface circuit is shown in Figure 4-1-2. The IFSEL2/SDO, IFSEL0/SCL/SCK and IFSEL1/SDA/SDI signals should be pulled high with 5.1k resistors at the end of the host. In SPI Slave mode, the host processor has to provide the SPI clock signal (SCK).

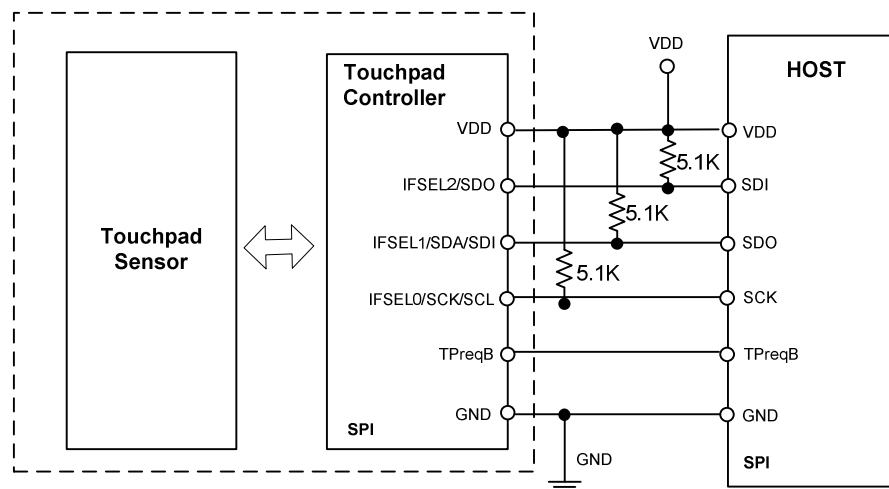


Figure 4-1-2 System block diagram with SPI Interface

If the eKT2101 is configured for SPI slave mode, the touchpad controller acts as slave and accepts new data from the master (host controller) into its shift register, while it transmits the requested data out of the shift register through its SPI transmit data pin-based on both, the clock rate and the selected edge.

In SPI slave mode, the touchpad controller supports a maximum SPI bit rate of 16Kbps. It detects each change of button state. To inform the host that new data is available, the eKT2101 will pull-low the TPreqB signal. After data transmission is finished, the touchpad controller will pull-high the TPreqB signal again (see Figure 4-1-2). One of transmitting or receiving command package type of eKT2101 is 4Bytes.

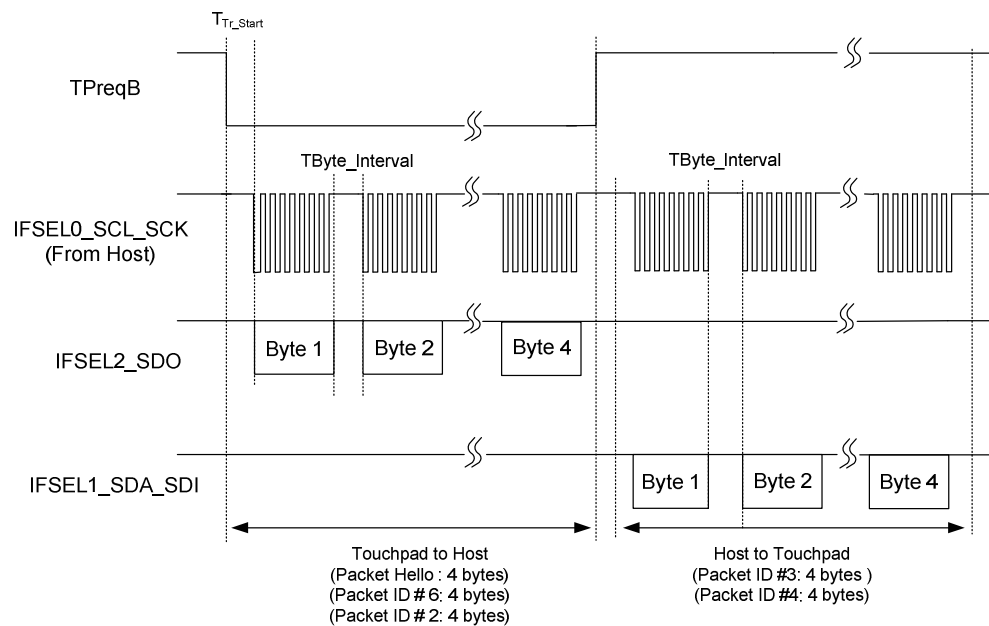


Figure 4-1-2 Data transmission and receiving in Slave Mode

In SPI slave mode, the eKT2101 will pull-low the TPreqB signal, when the host sends a command where the touchpad controller has to reply. The interval time between each byte, generated by the host, has to be longer than 50 μ s.

The commands received from the host always have priority. In case the touchpad controller is sending a Packet, while the host is sending a command, the touchpad controller will stop sending its Packet, start receiving the command from the host and respond accordingly.

4.2 I²C Slave Interface

All address packets are 9 bits long, consisting of 7 address bits, one READ/WRITE control bit and an acknowledge bit. When the touch pad controller recognizes that it is being addressed, it will acknowledge by pulling SDA low in the ninth SCL (ACK) cycle. All data packets are 9 bits long, consisting of one data byte and an acknowledge bit. An acknowledge (ACK) is signaled by the Receiver pulling the SDA line low during the ninth SCL cycle. If the Receiver leaves the SDA line high, a NACK is signaled. Each write or read cycle must end with a STOP condition.

Figure 4-2-1 and 4-2-2 show bit level waveform of I2C master Write/Read data to/from I2C slave device with 7 bit addressing mode. When R/~W bit is set to 0, I2C master can write data to I2C slave that only slave address is verified. On the contrary, when R/~W bit is set to 1, I2C master can read data from I2C slave if slave address is verified. If slave address verify is error, I2C slave will not work.

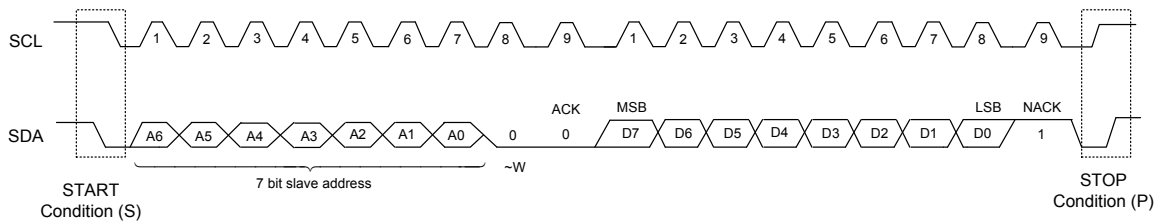


Fig. 4-2-1 Bit Level waveform of I2C master write data to I2C slave (~W=0)

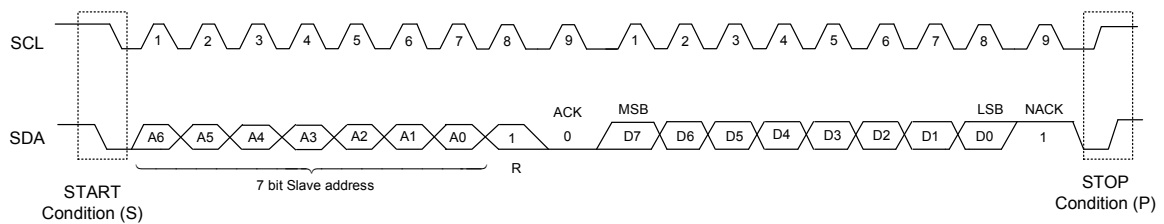


Fig. 4-2-2 Bit Level waveform of I2C master read data from I2C slave (R=1)

The I2C bit level waveform of Fig 4-2-1 and Fig 4-2-2 are supported by eKT2101. The eKT2101 touch pad controller is defined as a slave device of I2C and host is defined as a master. The device address of touch pad controller is designed as 7-bits address format. The touch pad controller address default is 0x10. If eKT2101 and other device setting have same I2C slave address, the developer can change other I2C slave address content of eKT2101 by writing Bit7~Bit1 of Register number 7 content. I2C slave address setting content range is 0x00~0x7F.

Slave address (A6~A0): 0x10 (default)

Or

Changing I2C slave address by setting bit7~bit1 of Register Number 7

Fig. 4-2-3 shows the system block diagram including I2C slave interface. The eKT2101 detects the object on the touch pad sensor and sends the information including button state to host. In I2C slave interface, the IFSEL0/SCL/SCK and IFSEL1/SDA/SDI signals should be pulled high with 5.1k resistors at the end of the host. Besides, the IFSEL2/SDO signal should be connected to ground to be pulled low at the end of the host. The host processor has to provide the I2C serial clock signal (SCL) to eKT2101.

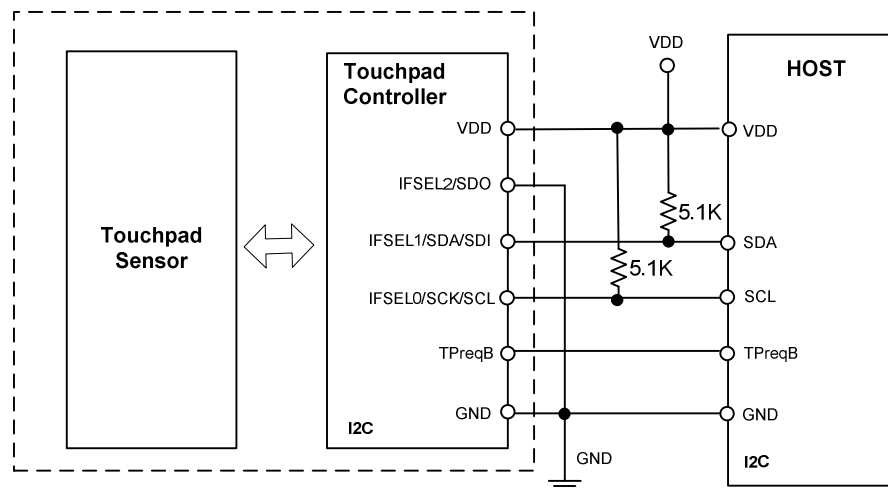
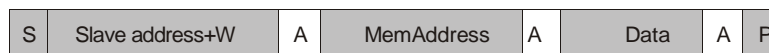


Figure 4-2-3 System block diagram with I2C Interface

An address packet consisting of a slave address and a READ or a WRITE bit is called Slave address+R or Slave address+W, respectively. The sequence of events required to write data to the touchpad controller is shown next.

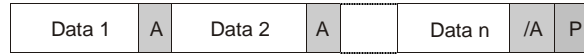
■ Host to Device □ Device to Host



S	Start condition
Slave address+W	Slave address plus write bit
A	Acknowledge bit
MemAddress	Target memory address within touchpad controller
Data	Data to be written
P	Stop condition

The sequence of events required to read data from the touchpad controller is shown next.

■ Host to Device □ Device to Host



S	Start condition
Slave address+W	Slave address plus write bit
A	Acknowledge bit
MemAddress	Target memory address within touchpad controller
Data	Data from touchpad controller
P	Stop condition
SLA+R	Slave address plus read bit
/A	Not Acknowledge bit/indicates last byte transmission

Touchpad controller detects each change of button state. The Host sends command to read back the touchpad data, after the command, the host must wait for 50µs and then receive the touchpad data. To inform the host that new data is available, the touchpad controller will pull-low the TPreqB signal. After data transmission, the touchpad controller will pull-high the TPreqB signal again (see Figure 4-2-4).

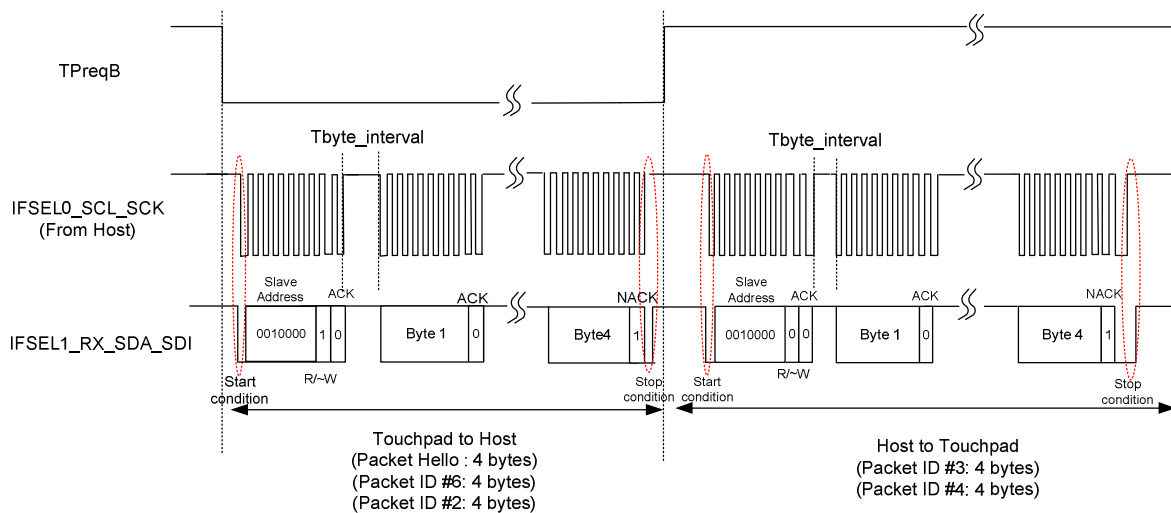
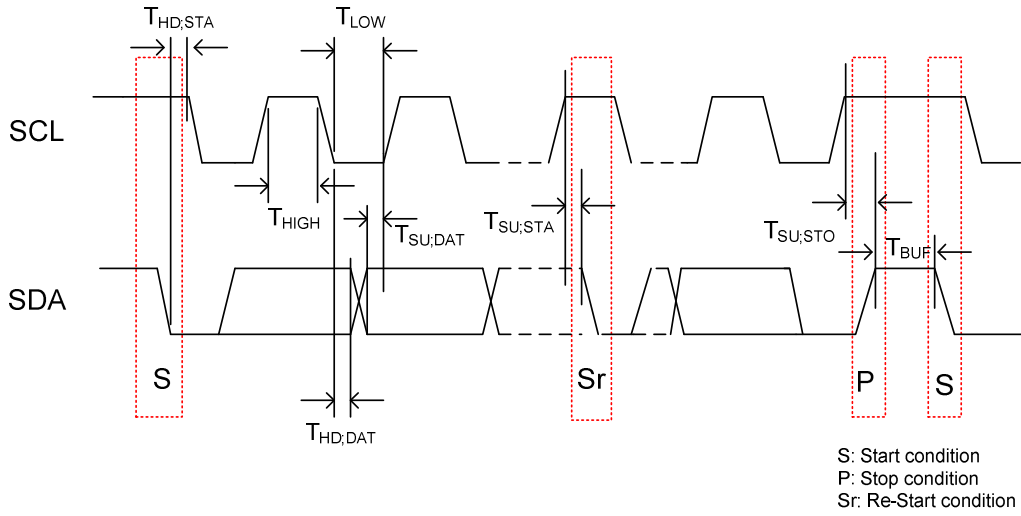


Fig. 4-2-4 Data transmission and Receiving in I2C slave mode

Fig.4-2-5 below shows the timing condition and characteristics of the I2C interface. In eKT2101, the touch pad adopts a bit rate of up to 100k bit/sec in the Standard mode. The I2C Fast-mode is not supported in eKT2101.



Fi

Figure 4-2-5 The Timing of I²C Interface

Table 1 Characteristics of the SDA and SCL pins for I2C interface

Symbol	Description	Standard Mode		Unit
		Min	Max	
F _{SCL}	SCL clock frequency	0	100	kHz
T _{HD,STA}	Hold time (repeated) START condition. After this period, the first clock pulse is generated.	4.0	-	us
T _{LOW}	LOW period of the SCL clock	4.7	-	Us
T _{HIGH}	HIGH period of the SCL clock	4.0	-	Us
T _{SU,STA}	Set-up time for a repeated START Condition	4.7	-	us
T _{HD,DAT}	Data hold time	0	-	us
T _{SU,DAT}	Data set-up time	250	-	ns
T _{SU,STO}	Set-up time for STOP condition	4.0	-	us
T _{BUF}	Bus free time between a STOP and START condition	4.7	-	us

5 Pin Assignment

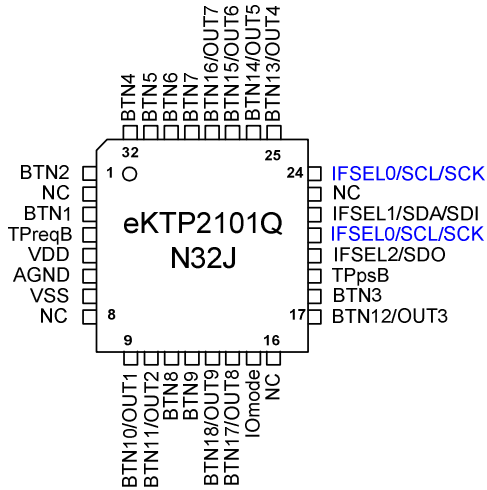


Figure 5-1 eKT2101QN32J

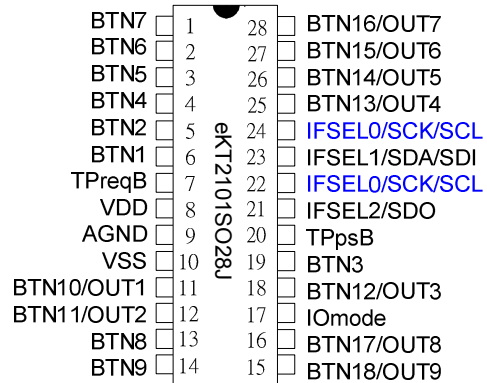


Figure 5-2 eKT2101SO28J

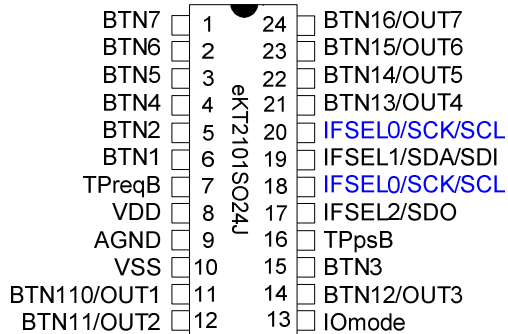


Figure 5-3 eKT2101SO24J

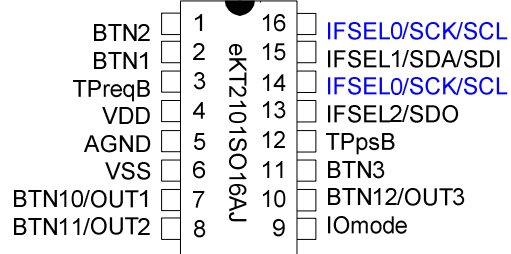


Figure 5-4 eKT2101SO16AJ



6 Pin Description

6.1 eKT2101QN32J

Symbol	Pin No.	Function Description
VDD	5	Power supply for IC emulation.It can be adjusted as per customer definition.
BTN1~BTN9	1, 3, 11, 12,18, 29, 30, 31, 32	Simulate switch signal from virtual button (BTN1~BTN9)
BTN10/OUT1~ BTN18/OUT9	9, 10, 13, 14, 17, 25, 26, 27, 28	This pins are used to button or button status output depend on operation mode selection.
TPreqB	4	TPreqB act as interrupt signal pin. If "TPreqB"=0, eKT2101QN32J has data packet to transmit. If "TPreqB"=1, eKT2101QN32J has no data packet to transmit and ready to receive command data from host.
IFSEL0/SCK/SCL	21, 24	The Pin number 21 and 24 must be connected together and rename to IFSEL0/SCK/SCL. In IOmode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101QN32J and Host at the beginning of power on. This pin acts as SCL/SCK signal of I2C/SPI after interface set. The operation interface selection please refer to Section "8.3" . In IOmode configures to VDD conditions: This pin acts as general input I/O for operation mode selection.
IFSEL1/SDA/SDI	22	In IOmode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101QN32J and Host at the beginning of power on. This pin acts as SDA/SDI signal of I2C/SPI after interface set. The operation interface selection please refer to Section "8.3" . In IOmode configures to VDD conditions: This pin acts as general input I/O for operation mode selection.
IFSEL2/SDO	20	In IOmode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101QN32J and Host at the beginning of power on. This pin acts as SDO signal of SPI after interface set. The operation interface selection please refer to Section "8.3" . In IOmode configures to VDD conditions: This pin acts as general input I/O for operation mode selection.
IOmode	15	I/O and Protocol mode select pin. If IOmode is connected to GND, eKT2101QN32J operates in Protocol



		mode. If IOMode is connected to VDD, eKT2101QN32J operates in I/O mode.
TPpsB	19	This pin is eKT2101QN32J power saving control signal. TPpsB set to "0", eKT2101QN32J will enter sleep mode TPpsB set to "01", eKT2101QN32J will wake up from sleep mode
VSS	7	Digital Ground
AGND	6	Analog Ground

6.2 eKT2101SO28J

Symbol	Pin No.	Function Description
VDD	8	Power supply for IC emulation. It can be adjusted as per customer definition.
BTN1~BTN9	6, 5, 4, 3, 2, 1, 13~14, 19	Simulate switch signal from virtual button (BTN1~BTN9).
BTN10/OUT1~ BTN18/OUT9	11,12,15,16,18 ,25,26,27,28	This pins are used to button or button status output depend on operation mode selection.
TPreqB	7	TPreqB act as interrupt signal pin. If "TPreqB"=0, eKT2101SO28J has data packet to transmit. If "TPreqB"=1, eKT2101SO28J has no data packet to transmit and ready to receive protocol command from host.
IFSEL0/SCK/SCL	22,24	The Pin number 22 and 24 must be connected together and rename to IFSEL0/SCK/SCL. In IOMode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101SO28J and Host at the beginning of power on. This pin acts as SCL/SCK signal of I2C/SPI after interface set. The operation interface selection please refer to Section "8.3" . In IOMode configures to VDD conditions: This pin acts as general input I/O for operation mode selection
IFSEL1/SDA/SDI	23	In IOMode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101SO28J and Host at the beginning of power on. This pin acts as SDA/SDI signal of I2C/SPI after interface set. The operation interface selection please refer to Section "8.3" . In IOMode configures to VDD conditions: This pin acts as general input I/O for operation mode selection.
IFSEL2/SDO	22	In IOMode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101SO28J and Host at the beginning of power on. This pin acts



		as SDO signal of SPI after interface set. The operation interface selection please refer to Section “8.3” . In IOmode configures to VDD conditions: This pin acts as general input I/O for operation mode selection.
IOmode	17	I/O and Protocol mode select pin. If IOmode is connected to GND, eKT2101SO28J operates in Protocol mode. If IOmode is connected to VDD, eKT2101SO28J operates in I/O mode.
TPpsB	20	This pin is eKT2101SO28J power saving control signal. TPpsB set to “0”, eKT2101SO28J will enter sleep mode TPpsB set to “1”, eKT2101SO28J wake up from sleep mode
VSS	10	Digital Ground
AGND	9	Analog Ground

6.3 eKT2101SO24J

Symbol	Pin No.	Function Description
VDD	8	Power supply for IC emulation. It can be adjusted as per customer definition.
BTN1~BTN7	6, 5, 4, 3, 2, 1, 15	Simulate switch signal from virtual button (BTN1~BTN7)
BTN10/OUT1~ BTN16/OUT7	11, 12, 14, 21, 22, 23, 24	This pins are used to button or button status output depend on operation mode selection.
TPreqB	7	TPreqB act as interrupt signal pin. If “TPreqB”=0, eKT2101SO24J has data packet to transmit. If “TPreqB”=1, eKT2101SO24J has no data packet to transmit and ready to receive protocol command from host.
IFSEL0/SCK/SCL	18,20	The Pin number 18 and 20 must be connected together and rename to IFSEL0/SCK/SCL. In IOmode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101SO24J and Host at the beginning of power on. This pin acts as SCL/SCK signal of I2C/SPI after interface set. The operation interface selection please refer to Section “8.3” . In IOmode configures to VDD conditions: This pin acts as general input I/O for operation mode selection
IFSEL1/SDA/SDI	19	In IOmode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101SO24J and Host at the beginning of power on. This pin acts as SDA/SDI signal of I2C/SPI after interface set. The operation



		interface selection please refer to Section “8.3” . In IOmode configures to VDD conditions: This pin acts as general input I/O for operation mode selection.
IFSEL2/SDO	17	In IOmode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101SO24J and Host at the beginning of power on. This pin acts as SDO signal of SPI after interface set. The operation interface selection please refer to Section “8.3” . In IOmode configures to VDD conditions: This pin acts as general input I/O for operation mode selection.
IOmode	13	I/O and Protocol mode select pin. If IOmode is connected to GND, eKT2101SO24J operates in Protocol mode. If IOmode is connected to VDD, eKT2101SO24J operates in I/O mode.
TPpsB	16	This pin is eKT2101SO24J power saving control signal. TPpsB set to “0”, eKT2101SO24J will enter sleep mode TPpsB set to “1”, eKT2101SO24J wake up from sleep mode
VSS	10	Digital Ground
AGND	9	Analog Ground

6.4 eKT2101SO16AJ

Symbol	Pin No.	Function Description
VDD	4	Power supply for IC emulation. It can be adjusted by customer define.
BTN1~BTN3	2~1,11	Simulate switch signal from virtual button(BTN1~BTN3)
BTN10/OUT1~ BTN12/OUT3	10, 8, 7	This pins are used to button or button status output depend on operation mode selection.
TPreqB	3	TPreqB act as interrupt signal pin. If “TPreqB”=0, eKT2101SO16AJ has data packet to transmit. If “TPreqB”=1, eKT2101SO16AJ has no data packet to transmit and ready to receive protocol command from host.
IFSEL0/SCK/SCL	14,16	The Pin number 14 and 16 must be connected together and rename to IFSEL0/SCK/SCL. In IOmode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101SO16AJ and Host at the beginning of power on. This pin acts as SCL/SCK signal of I2C/SPI after interface set. The operation interface selection please refer to Section “8.3” .



		<p>In IOMode configures to VDD conditions: This pin acts as general input I/O for operation mode selection</p>
IFSEL1/SDA/SDI	15	<p>In IOMode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2104 and Host at the beginning of power on. This pin acts as SDA/SDI signal of I2C/SPI after interface set. The operation interface selection please refer to Section “8.3” .</p> <p>In IOMode configures to VDD conditions: This pin acts as general input I/O for operation mode selection.</p>
IFSEL2/SDO	13	<p>In IOMode configures to GND condition: This pin is used to decide operation Interface (I2C/SPI) Between eKT2101SO16AJ and Host at the beginning of power on. This pin acts as SDO signal of SPI after interface set. The operation interface selection please refer to Section “8.3” .</p> <p>In IOMode configures to VDD conditions: This pin acts as general input I/O for operation mode selection.</p>
IOMode	9	<p>I/O and Protocol mode select pin.</p> <p>If IOMode is connected to GND, eKT2101SO16AJ operates in Protocol mode.</p> <p>If IOMode is connected to VDD, eKT2101SO16AJ operates in I/O mode.</p>
TPpsB	12	<p>This pin is eKT2101SO16AJ power saving control signal. Host set to “0”, eKT2101SO16AJ will enter sleep mode. Host set to “1”, eKT2101SO16AJ wake up from sleep mode mode.</p>
VSS	6	Digital Ground
AGND	5	Analog Ground

7 Timing Description

7.1 Power-on Reset

After the touchpad is powered on, this controller will do initialization. The initialization includes MCU and analog parameter initialization. After the initial process, it will send “Packet Hello” to let the host know that the touchpad is ready to work. Host must be release bus during touchpad getting interface configuration to make sure touchpad getting interface correctly. The release time (T_r) is 10 ms. Figure 7-1-1 shows the process after power up. Touchpad power-on time is 350ms.

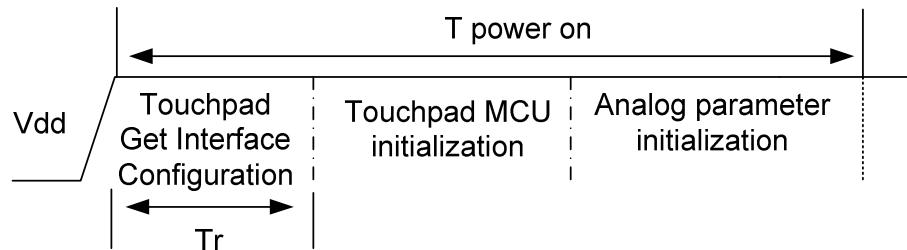


Figure 7-1-1 Power-on Reset Timing Diagram

7.2 Wake-up Timing

Figure 7-2-1 below shows eKT2101 wake-up time from sleep mode.

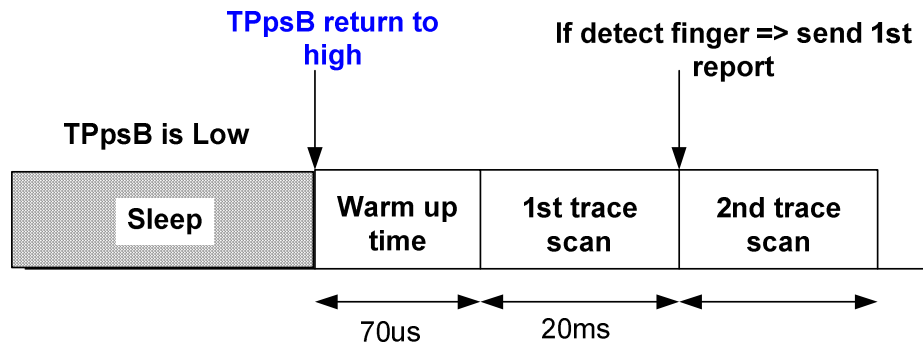


Figure 7-2-1 Wake-up Timing from Deep Sleep

8 Special Pin Description

8.1 IOmode Pin

Input pin is used to decide eKT2101 operation in IO or Protocol mode. When IOmode pin input to high level, eKT2101 operate in IO mode. IFSEL2, IFSEL1, and IFSEL0 are set to general purpose input I/O, and it can be used in Direct Key function mode directly, and do not need to be set through interface protocol. When IOmode pin input to low level, eKT2101 operate in Protocol mode. In this mode, IFSEL2, IFSEL1, and IFSEL0 are set to select pin by interface. Using for selecting I2C and SPI interfaces, HOST can use command to control eKT2101 through protocol interface.

8.2 Direct Key selection of IO mode (IOmode Pin=1)

IOmode	IFSEL2	IFSEL1	IFSEL0	Direct Key
1	0	0	0	eKT2101QN32J without Multi-Key function (9 Direct Key Mode)
	0	0	1	eKT2101SO28J without Multi-Key function (9 Direct Key Mode)
	0	1	0	eKT2101SO24J without Multi-Key function (7 Direct Key Mode)
	0	1	1	eKT2101SO16AJ without Multi-Key function (3 Direct Key Mode)
	1	0	0	eKT2101QN32J with Multi-Key function (9 Direct Key Mode)
	1	0	1	eKT2101SO28J with Multi-Key function (9 Direct Key Mode)
	1	1	0	eKT2101SO24J with Multi-Key function (7 Direct Key Mode)
	1	1	1	eKT2101SO16AJ with Multi-Key function (3 Direct Key Mode)

*When IOmode set to 0, Touch pad controller also supports direct key function. The developer must select Direct Key operation mode (Register Number 3) by protocol interface. Bit 15 of Register Number 3 can decide IO output control of direct key by eKT2101 or developer.

8.3 Interface Selection of Protocol mode (IOmode Pin=0)

If system operate in Protocol mode (IOmode Pin=0), it need to use IFSEL2, IFSEL1, and IFSEL0 Pins to set communication interface before system power on.

The following are the setting methods:

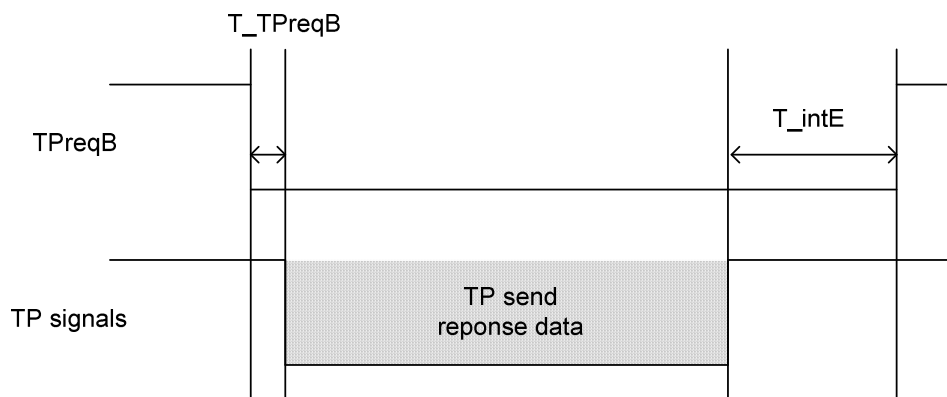
IOmode	IFSEL2	IFSEL1	IFSEL0	Interface
0	High	High	High	SPI
	Low	High	High	I2C

For each interface, the valid pins are

1. SPI Slave mode : SCK/SCL, SDI/SDA, SDO
2. I2C slave mode : SCK/SCL, SDI/SDA

8.4 TPreqB Pin

The TPreqB state is always high. In SPI slave or I²C slave mode, if the eKT2101 detects the button state has changed, it will pull the TPreqB signal low first. After the host sends the clock signal to the touchpad, the eKT2101 will send a response data, and after data transmission, the touchpad controller will pull-high the TPreqB signal again.



TPreqB Signal	Condition		Description
T_TPreqB	0us(min.)	5us(Typ.)	Minimum preparation time from pulling the TPreqB low and begin sending response data
T_intE	5us(max.)	1us(Typ.)	Maximum preparation time to end sending response data and pulling the TPreqB high



9 Electrical Characteristics

9.1 Absolute Maximum Ratings

Items	Rating		
Temperature under bias	-40°C	to	85°C
Storage temperature	-65°C	to	150°C
Input voltage	V _{ss} -0.3V	to	V _{dd} +0.5V
Output voltage	V _{ss} -0.3V	to	V _{dd} +0.5V
Working Voltage	3V	to	5.5V
Working Frequency	DC	to	4 MHz

9.2 DC Electrical Characteristics

(T_a = -40~85°C, V_{SS} = 0V, C_x = 5pF)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
DVDD	Power supply voltage request	General purpose	3	-	5.5	V
I_Normal 1	Normal operating current	/RESET= 'High', IRC=4MHz @ 5V	3.9	4.2	4.4	mA
I_Normal 2	Normal operating current	/RESET= 'High', IRC=4MHz @ 3V	2.4	2.6	2.8	mA
I_Idle 1	Idle operating current	/RESET= 'High', IRC=4MHz @ 5V	-	150	-	μA
I_Idle 2	Idle operating current	/RESET= 'High', IRC=4MHz @ 3V	-	100	-	μA
I_sleep 1	Sleep operating current	/RESET= 'High', IRC=4MHz @ 5V	-	2	-	μA
I_sleep 2	Sleep operating current	/RESET= 'High', IRC=4MHz @ 3V	-	2	-	μA
MCU Operation						
IIL	Input Leakage Current for input pins	V _{IN} = V _{DD} , V _{SS}	-1	0	1	μA
VIH	Input High Voltage (Schmitt trigger)	Power supply	0.7V _{DD}	-	V _{DD} +0.3V	V
VIL	Input Low Voltage (Schmitt trigger)	Power supply	-0.3V	-	0.3V _{DD}	V
IOH	Output High Voltage	VOH = V _{DD} -0.1V _{DD} (IOH =10mA)	11	12	13.5	mA
IOL	Output Low Voltage	VOL = GND+0.1V _{DD} (IOL =20mA)	22	24	27	mA

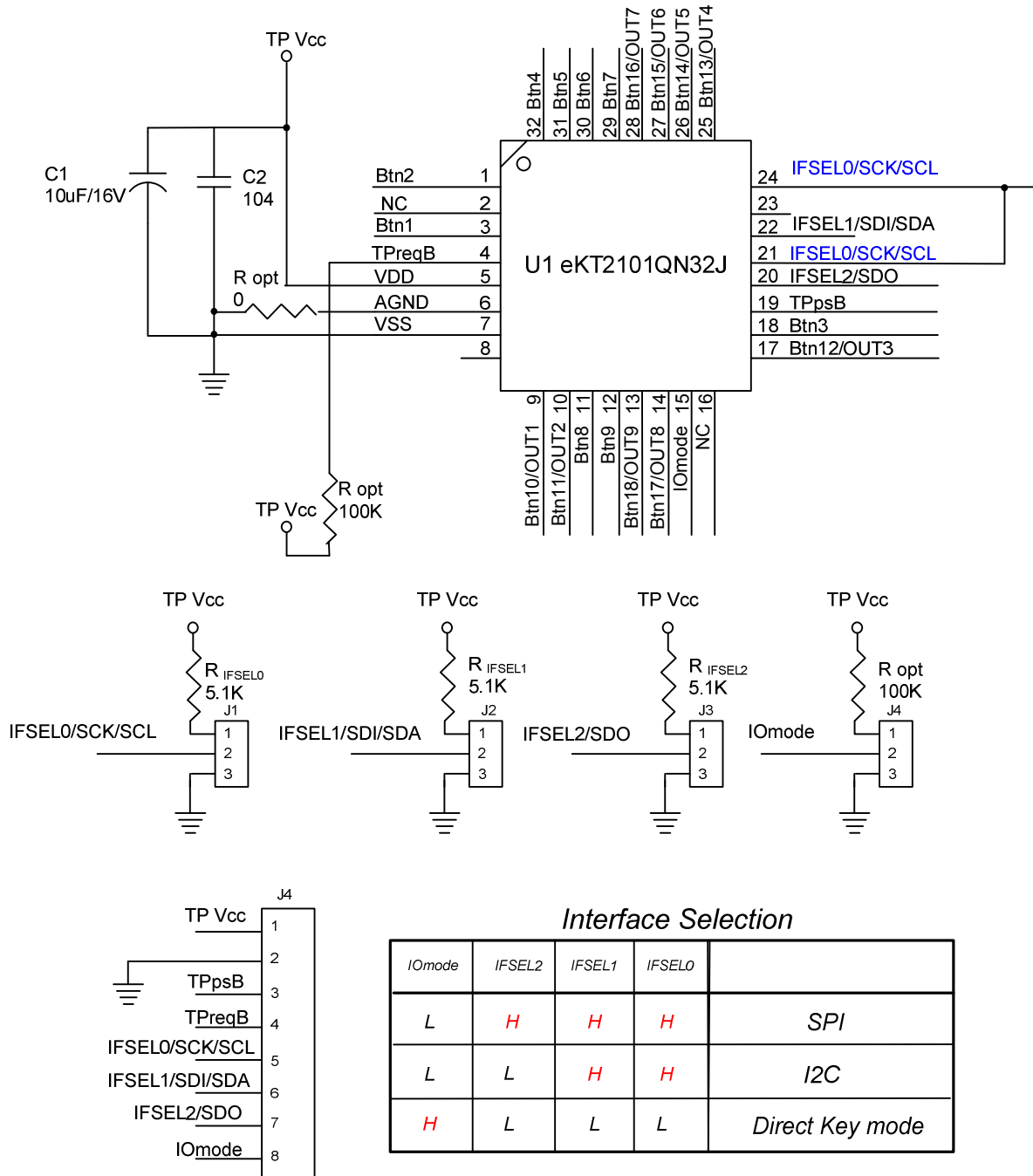
9.3 AC Electrical Characteristics

(T_a = -40~85°C, V_{dd} = 5V, V_{SS} = 0V)

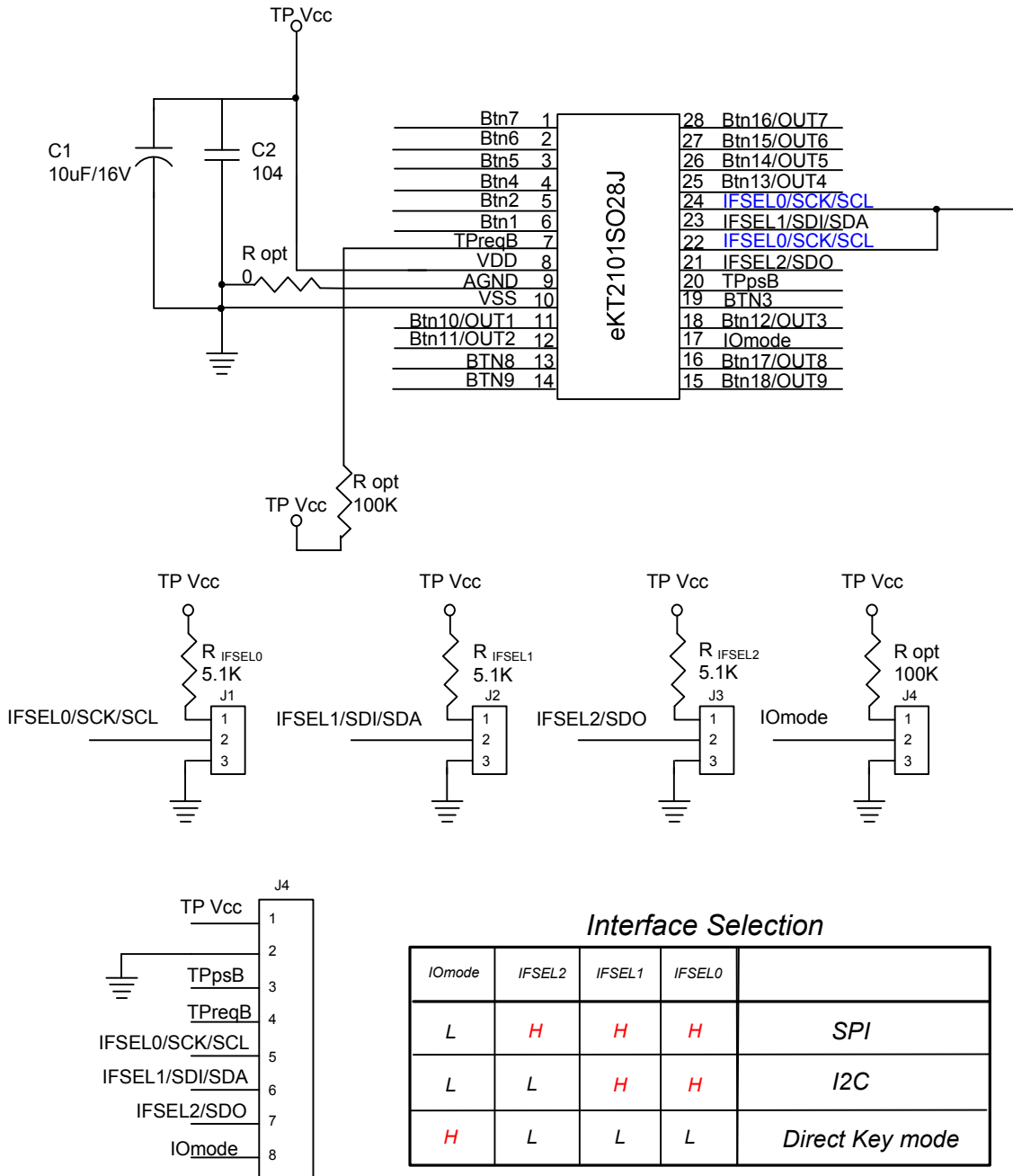
Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
IRC1	IRC : VDD to 5V	RCM0 : RCM1=1:1	3.68	4	4.32	MHz

10 Application Circuit

10.1 eKT2101QN32J Application Circuit



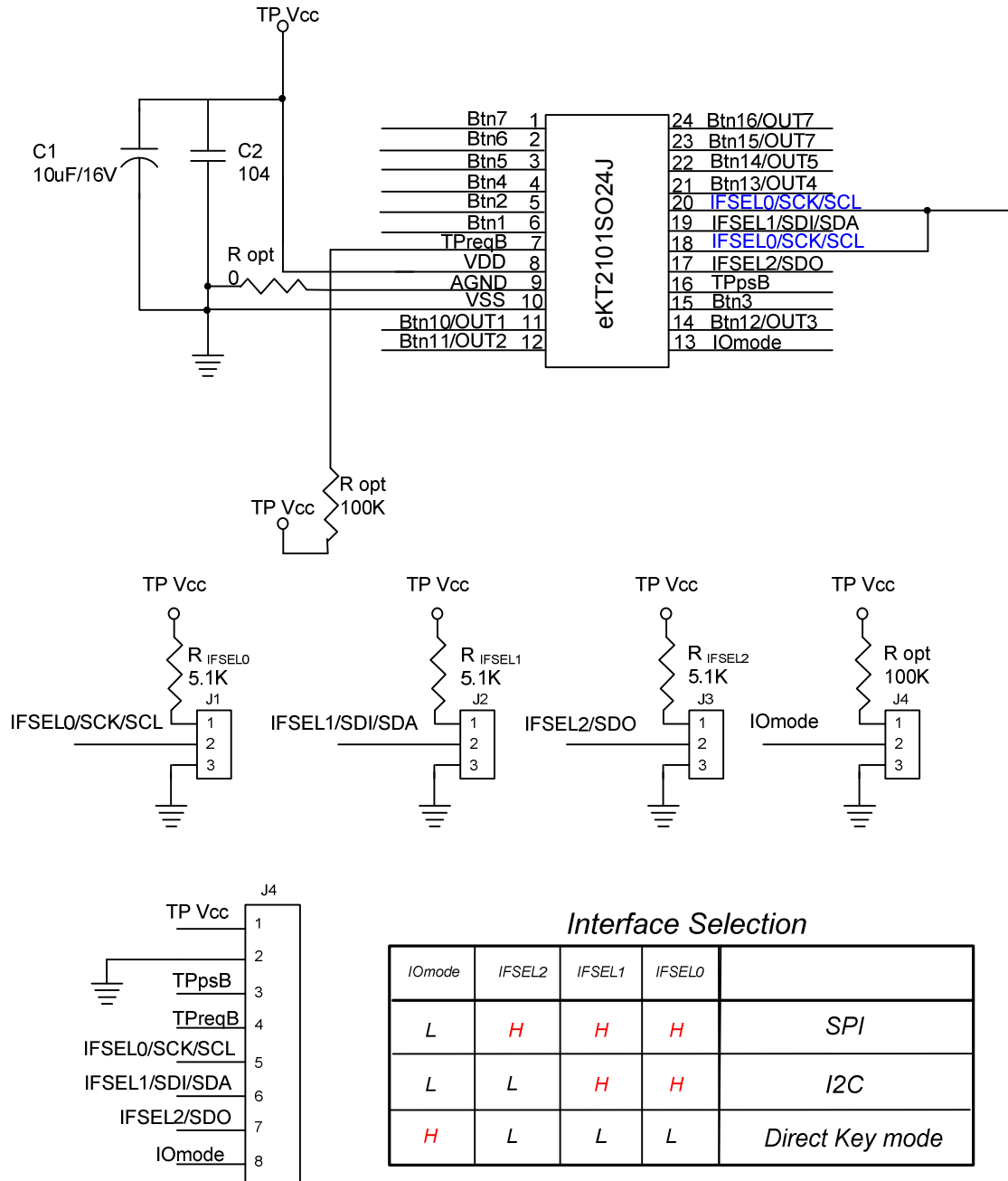
10.2 eKT2101SO28J Application Circuit



Interface Selection

IOmode	IFSEL2	IFSEL1	IFSEL0	
L	H	H	H	SPI
L	L	H	H	I2C
H	L	L	L	Direct Key mode

10.3 eKT2101SO24J Application Circuit

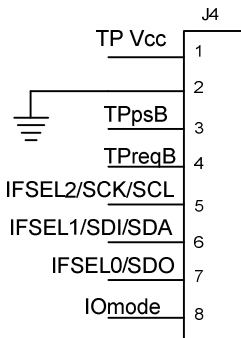
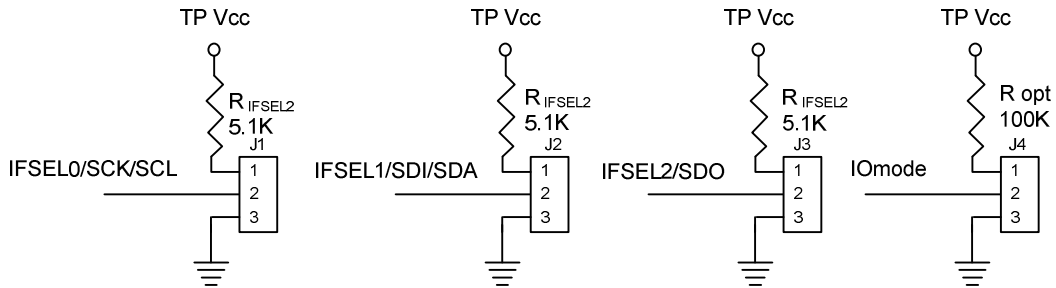
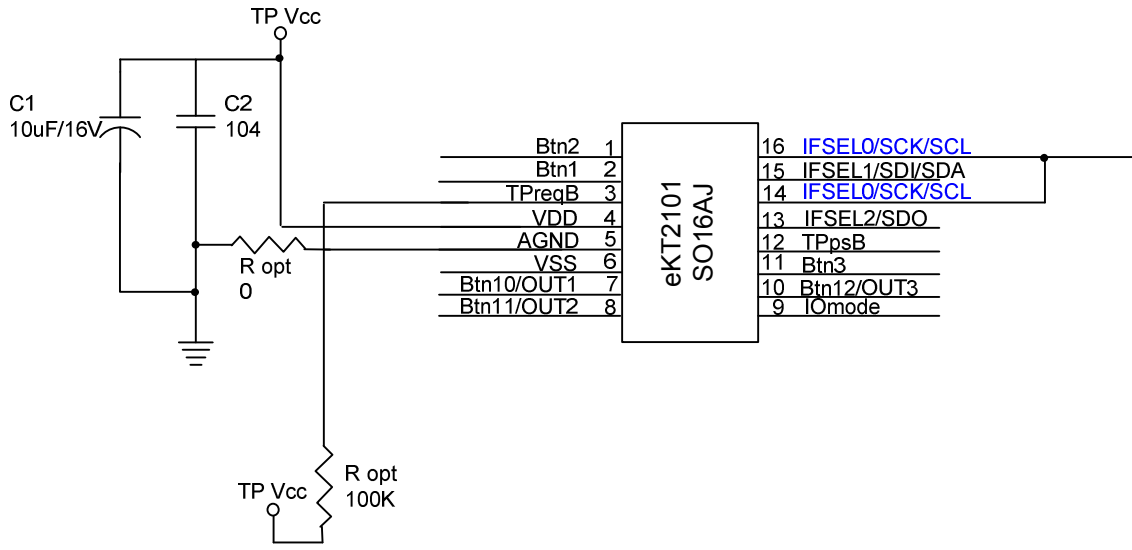


Interface Selection

IOMode	IFSEL2	IFSEL1	IFSEL0	
L	H	H	H	SPI
L	L	H	H	I2C
H	L	L	L	Direct Key mode



10.4 eKT2101SO16AJ Application Circuit



Interface Selection

IOmode	IFSEL2	IFSEL1	IFSEL0	
L	H	H	H	SPI
L	L	H	H	I2C
H	L	L	L	Direct Key mode

11 Protocol Description

After power on, the touch pad (TP) will send “Packet Hello” to let the host know that TP is ready for operation. When TP detects button status change, it then sends the new information to host.

The TP always sends Packet ID #6 unless specifically asked by the host to send another type. In the case of sending another Packet ID, the TP will only send once for each request by the host and then revert to the type of Packet ID #6. The touch pad will send Packet ID #6 packet whenever it detects a change of sensing status.

Host can change the Touch pad’s power status or sensitivity by sending Packet ID #4 with the correct register number. It can also read information immediately by sending

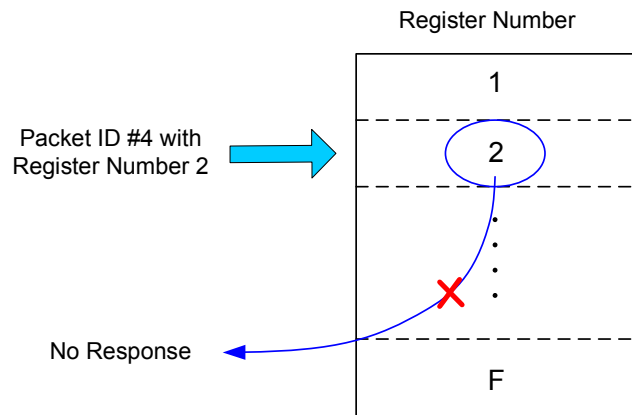


Fig.11-1. Host writes data to Touchpad controller by using Packet ID #4

Packet ID #3 with the correct register number; then TP will send Packet ID #2 in response to this command. No matter which interfaces are used, the definition of the report packet is the same.

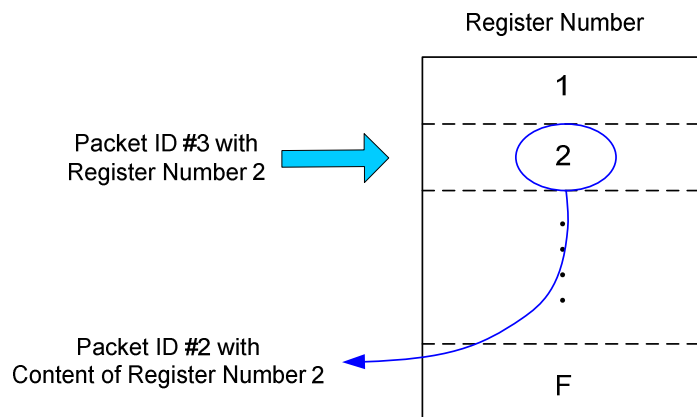


Fig.11-2. Host reads data from Touchpad controller by using Packet ID #3

11.1 Command Description

11.1.1 Packet Hello (Device to Host)

31	30~24	23~16	15~8	7~1	0
0	1010101	01010101	01010101	0101010	1

After the touch pad is powered on, TP will send "Packet Hello" to host

11.1.2 Packet ID #6 (Device to Host)

	Type	PID	Reserve	BTN18~BTN1	Reserve	
31	30~28	27~24	23~20	19~2	1	0
0	101	0110	0000	1: ON; 0: OFF	0	1

The eKT2101 segregates the buttons information. For the button information, the eKT2101 kernel will calculate the weight of every pressed button and output the highest sensing button. The button timing diagram is shown in Fig.11-1-1.

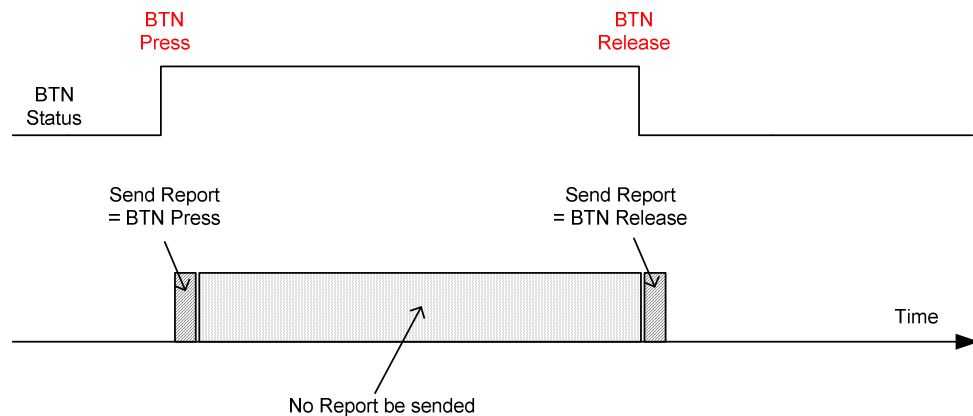


Fig.11-1-1. Button Timing Diagram

In Button mode:

Reserve

- Bit 19** Btn1 .1 = Button pressed, 0 = Button released
- Bit 18** Btn2 .1 = Button pressed, 0 = Button released
- Bit 17** Btn3 .1 = Button pressed, 0 = Button released
- Bit 16** Btn4 .1 = Button pressed, 0 = Button released
- Bit 15** Btn5 .1 = Button pressed, 0 = Button released
- Bit 14** Btn6 .1 = Button pressed, 0 = Button released
- Bit 13** Btn7 .1 = Button pressed, 0 = Button released
- Bit 12** Btn8 .1 = Button pressed, 0 = Button released
- Bit 11** Btn9 .1 = Button pressed, 0 = Button released
- Bit 10** Btn10 .1 = Button pressed, 0 = Button released



Bit 09 Btn11 1 = Button pressed, 0 = Button released

Bit 08 Btn12 1 = Button pressed, 0 = Button released

Bit 07 Btn13 1 = Button pressed, 0 = Button released

Bit 06 Btn14 1 = Button pressed, 0 = Button released

Bit 05 Btn15 1 = Button pressed, 0 = Button released

Bit 04 Btn16 1 = Button pressed, 0 = Button released

Bit 03 Btn17 1 = Button pressed, 0 = Button released

Bit 02 Btn18 1 = Button pressed, 0 = Button released

The maximum supports 18 button function (Btn1~Btn18) in eKT2101QN32J/SO28J; the maximum supports 14 button function (Btn1~Btn14) in eKT2101SO24J; the maximum supports 6 button function (Btn1~Btn6) in eKT2101SO16AJ.

In Direct Key Mode:

Bit 19 Btn1 1 = Button pressed, 0 = Button released

Bit 18 Btn2 1 = Button pressed, 0 = Button released

Bit 17 Btn3 1 = Button pressed, 0 = Button released

Bit 16 Btn4 1 = Button pressed, 0 = Button released

Bit 15 Btn5 1 = Button pressed, 0 = Button released

Bit 14 Btn6 1 = Button pressed, 0 = Button released

Bit 13 Btn7 1 = Button pressed, 0 = Button released

Bit 12 Btn8 1 = Button pressed, 0 = Button released

Bit 11 Btn9 1 = Button pressed, 0 = Button released

Bit 10~Bit 2 are 0's

The maximum supports 9 Direct Key function (Btn1~Btn9) in eKT2101QN32J/SO28J; the maximum supports 7 Direct Key function (Btn1~Btn7) in eKT2101SO24J; the maximum supports 3 Direct Key function (Btn1~Btn6) in eKT2101SO16AJ.

EX: If Btn1 is pressed, the packet is 0B01010110 00001000 00000000 00000001.

EX: If Btn9 is pressed, the packet is 0B01010110 00000000 00001000 00000001.

EX: If the Button status is released, the bits will be 0.

**11.1.3 Packet ID #2 (Device to Host)**

	Type	PID	Register No.	Read Register Response Data	
31	30~28	27~24	23~20	19~1	0
0	101	0010	-	-	1

The Touch pad will send this packet in response to Packet ID #3. The response data is determined by the register number in Packet ID #3. Refer to register number description.

EX: Host send command to read TP's button status, if Btn1 is pressed, the packet is 0B01010010 00011000 00000000 00000001.

EX: Host send command to read TP's button status, if Btn6 is pressed, the packet is 0B01010010 00010000 01000000 00000001.

11.1.4 Packet ID #3 (Host to Device)

	Type	PID	Register No.	Reserve	
31	30~28	27~24	23~20	19~1	0
0	101	0011	-	-	1

This is a read command packet. The Host can read the information in different register number. Refer to register number description.

EX: If Host want to read TP's button status, it should send command to TP and the packet is 0B01010011 00010000 00000000 00000001.

EX: If Host want to read TP's sensitivity, it should send command to TP and the packet is 0B01010011 01000000 00000000 00000001.

11.1.5 Packet ID #4 (Host to Device)

	Type	PID	Register No.	Register Data	
31	30~28	27~24	23~20	19~1	0
0	101	0100	-	-	1

Comment: This is a write command packet. Host can change the TP's status, like Sensitivity or the Power State via sending this packet. Refer to register number description.

EX: If host wants to change the all buttons sensitivity to 5, the packet is 0B01010100 01000000 00011111 01010001.



EX: If host wants to execute the calibration, the packet is 0B01010100 01101000
00000000 00000001.

11.2 Register Description

The register numbers in Packet ID #2, Packet ID #3 and Packet ID #4 are defined as follows:

11.2.1 Register Number=0, Read F/W Version and OTP Info. (Read Only)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	0000	00000000 00000000	000	1

If the host wants to read the firmware version of the touch pad, it should send Packet ID #3 with register number 0000.

	Type	PID	Register No.	Read Register data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	0000	00000001 00000000	000	1

The touch pad will then return the firmware version by sending Packet ID #2 to host.

Bit 19 ~ Bit 16: Major Version

Bit 15 ~ Bit 8: Minor Version

Bit 7 ~ Bit 4: OTP burning information

11.2.2 Register Number=1, Read Button Status (Read Only)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	0001	00000000 00000000	000	1

If the host wants to read the button status of the touch pad, it should send Packet ID #3 with register number 0001.

	Type	PID	Register No.	Read Register data	Reserve	
31	30~28	27~24	23~20	19~2	1	0
0	101	0010	0001	000000000000000000	0	1

31 30~28 27~24 The touch pad will then return the button status by sending Packet ID #2 to host.



In Button Mode:

- Bit 19** Btn1 .1 = Button pressed, 0 = Button released
- Bit 18** Btn2 .1 = Button pressed, 0 = Button released
- Bit 17** Btn3 .1 = Button pressed, 0 = Button released
- Bit 16** Btn4 .1 = Button pressed, 0 = Button released
- Bit 15** Btn5 .1 = Button pressed, 0 = Button released
- Bit 14** Btn6 .1 = Button pressed, 0 = Button released
- Bit 13** Btn7 .1 = Button pressed, 0 = Button released
- Bit 12** Btn8 .1 = Button pressed, 0 = Button released
- Bit 11** Btn9 .1 = Button pressed, 0 = Button released
- Bit 10** Btn10 .1 = Button pressed, 0 = Button released
- Bit 09** Btn11 .1 = Button pressed, 0 = Button released
- Bit 08** Btn12 .1 = Button pressed, 0 = Button released
- Bit 07** Btn13 .1 = Button pressed, 0 = Button released
- Bit 06** Btn14 .1 = Button pressed, 0 = Button released
- Bit 05** Btn15 .1 = Button pressed, 0 = Button released
- Bit 04** Btn16 .1 = Button pressed, 0 = Button released
- Bit 03** Btn17 .1 = Button pressed, 0 = Button released
- Bit 02** Btn18 .1 = Button pressed, 0 = Button released

The maximum supports 18 button function (Btn1~Btn18) in eKT2101QN32J/SO28J; the maximum supports 14 button function (Btn1~Btn14) in eKT2101SO24J; the maximum supports 6 button function (Btn1~Btn6) in eKT2101SO16AJ.

In Direct Key Mode:

- Bit 19** Btn1 .1 = Button pressed, 0 = Button released
- Bit 18** Btn2 .1 = Button pressed, 0 = Button released
- Bit 17** Btn3 .1 = Button pressed, 0 = Button released
- Bit 16** Btn4 .1 = Button pressed, 0 = Button released
- Bit 15** Btn5 .1 = Button pressed, 0 = Button released
- Bit 14** Btn6 .1 = Button pressed, 0 = Button released
- Bit 13** Btn7 .1 = Button pressed, 0 = Button released
- Bit 12** Btn8 .1 = Button pressed, 0 = Button released
- Bit 11** Btn9 .1 = Button pressed, 0 = Button released
- Bit 10~Bit 2** are 0's



The maximum supports 9 Direct Key function (Btn1~Btn9) in eKT2101QN32J/SO28J; the maximum supports 7 Direct Key function (Btn1~Btn7) in eKT2101SO24J; the maximum supports 3 Direct Key function (Btn1~Btn6) in eKT2101SO16AJ.

11.2.3 Register Number=2, Host control Direct Key I/O output Setting (R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	0010	00000000 00000000	000	1

If host wants to read the Scan-Buttons numbers of touch pad, it should send Packet ID #3 with register number 0010.

	Type	PID	Register No.	Read Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	0010	00000000 00000000	000	1

The touch pad will then return the Scan-Buttons numbers of touch pad by sending Packet ID #2 to host.

When Bit 19~Bit17 of Register Number 3 set to 001(Direct Key mode) and Bit15 of Register Number 3 is set, developer can use this content of register to set the output status of Direct I/O (HIGH or LOW). If Bit 9 of register Number 3 is disabled, this register is the same as NA.

- Bit 16** Out9 .1 = Output high, 0 = Output low
- Bit 15** Out8 .1 = Output high, 0 = Output low
- Bit 14** Out7 .1 = Output high, 0 = Output low
- Bit 13** Out6 .1 = Output high, 0 = Output low
- Bit 12** Out5 .1 = Output high, 0 = Output low
- Bit 11** Out4 .1 = Output high, 0 = Output low
- Bit 10** Out3 .1 = Output high, 0 = Output low
- Bit 9** Out2 .1 = Output high, 0 = Output low
- Bit 8** Out1 .1 = Output high, 0 = Output low

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	0010	00000000 00000000	000	1



If the host wants to write the Scan-Buttons numbers of the touch pad, it should send Packet ID #4 with register number 0010. Then the touch pad will keep the value.

- Bit 16** Out9 .1 = Output high, 0 = Output low
- Bit 15** Out8 .1 = Output high, 0 = Output low
- Bit 14** Out7 .1 = Output high, 0 = Output low
- Bit 13** Out6 .1 = Output high, 0 = Output low
- Bit 12** Out5 .1 = Output high, 0 = Output low
- Bit 11** Out4 .1 = Output high, 0 = Output low
- Bit 10** Out3 .1 = Output high, 0 = Output low
- Bit 9** Out2 .1 = Output high, 0 = Output low
- Bit 8** Out1 .1 = Output high, 0 = Output low

If host set Out7 and Out4 output high, others are output low. The packet is 0B 01010100 0010 0000 01001000 00000001

11.2.4 Register Number = 3, Operation Setting (R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	0011	00000000 00000000	000	1

If host wants to read the operation setting at present, it should send Packet ID #3 with register number 0011.

	Type	PID	Register No.	Read Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	0011	00000000 00000000	000	1

The touch pad will then return the eKT2101 operation setting by sending Packet ID #2 to host.

- Bit 19~Bit 17:** Operation mode select.
 - 000: Button mode (Default)
 - 001: Direct key mode
 - Others: Reserved

Bit 16: Multi-Key touch control setting. After this function is enabled, it can be allowed to touch two keys or above at the same time. If disable, only can touch one key.



- 0: Disable.
- 1: Enable

Bit 15: Direct Key IO output by developer. When touchpad operate in Direct Key mode and this bit is enabled, developer can set content of Register Number 2 to decide IO output status of Direct Key. **This control bit isn't act in Button mode (Bit 19~Bit 17=000).**

- 0: Disable. (Direct Key output control by eKT2101 touchpad controller)
- 1: Enable. (Direct Key output control by setting content of Register Number 2)

Bit 14 ~ Bit 13: Package-Type selection. To choose corresponding to package function that eKT2101 provides.

- 00: eKT2101 run QFN32. The default total Scan-Buttons of eKT2101 are 18 buttons.
- 01: eKT2101 run SOP28. The default total Scan-Buttons of eKT2101 are 18 buttons.
- 10: eKT2101 run SOP24. The default total Scan-Buttons of eKT2101 are 14 buttons.
- 11: eKT2101 run SOP16. The default total Scan-Buttons of eKT2101 are 6 buttons.

Bit 12 ~ Bit 8: Scan-Buttons numbers. The setting numbers of Scan Button can not be over the biggest Buttons number. The biggest Buttons of eKT2101 determine the package type. Please refer to the below information:

eKT2101 Package-Type	Button mode	Direct Key mode
QFN32	18	9
SOP28	18	9
SOP24	14	7
SOP16	6	3

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	0011	00000000 00000000	000	1

If the host wants to write the operation setting of the touch pad, it should send Packet ID #4 with register number 0011. Then the touch pad will keep the value.

Bit 19~Bit 17: Operation mode select.



000: Button mode (Default)

001: Direct key mode

Others: Reserved

Bit 16: Multi-Key touch control setting. After this function is enabled, it can be allowed to touch two keys or above at the same time. If disable, only can touch one key.

0: Disable.

1: Enable

Bit 15: Direct Key IO output by developer. When touchpad operate in Direct Key mode and this bit is enabled, developer can set content of Register Number 2 to decide IO output status of Direct Key. **This control bit isn't act in Button mode (Bit 19~Bit 17=000).**

0: Disable. (Direct Key output control by eKT2101 touchpad controller)

1: Enable. (Direct Key output control by setting content of Register Number 2)

Bit 14 ~ Bit 13: Package-Type selection. To choose corresponding to package function that eKT2101 provides.

00: eKT2101 run QFN32. The default total Scan-Buttons of eKT2101 are 18 buttons.

01: eKT2101 run SOP28. The default total Scan-Buttons of eKT2101 are 18 buttons.

10: eKT2101 run SOP24. The default total Scan-Buttons of eKT2101 are 14 buttons.

11: eKT2101 run SOP16. The default total Scan-Buttons of eKT2101 are 6 buttons.

Bit 12 ~ Bit 8: Scan-Buttons numbers. The setting numbers of Scan Button can not be over the biggest Buttons number. The biggest Buttons of eKT2101 determine the package type. Please refer to the below information:

eKT2101 Package-Type	Button mode	Direct Key mode
QFN32	18	9
SOP28	18	9
SOP24	14	7
SOP16	6	3



11.2.5 Register Number = 4, TP Sensitivity Setting(R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	0100	00000000 00000000	000	1

If host wants to read the sensitivity of touch pad, it should send Packet ID #3 with register number 0100.

	Type	PID	Register No.	Read Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	0100	00000000 00000000	000	1

The touch pad will then return the sensitivity by sending Packet ID #2 to host.

Bit 12~ Bit 8: Button select.

Button Select	Description
0~17	For setting the specific button Ex: 00000 -> Btn1
18~30	Revered
31	For setting all of the buttons, and not support reading

Bit 7 ~ Bit 4: Sensitivity, the sensitivity range is 0 ~ 15. Default value is 7.

EX: If host send reading sensitivity of Button 5 command to TP and TP's sensitivity is 3. Touch pad will return 0B 01010010 01000000 00000101 00110001

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	0100	00000000 00000000	000	1

Type PID Regis If the host wants to write the sensitivity of the touch pad, it should send Packet ID #4 with register number 0100. Then the touch pad will keep the value.

Bit 12~ Bit 8: Button select

Button Select	Description
0~17	For setting the specific button Ex: 00000 -> Btn1
18~30	Revered
31	For setting all of the buttons,



and not support reading

Bit 7 ~ Bit 4: Sensitivity, the sensitivity range is 0 ~ 15. The default value is 7

11.2.6 Register Number = 5, Power Saving & Calibration Speed & Direct Key I/O Pressed State Setting(R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~3	3~1	0
0	101	0011	0101	00000000 00000000	000	1

If host wants to read the Power saving time of the touch pad, it should send Packet ID #3 with register number 0101.

	Type	PID	Register No.	Read Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	0101	00000000 00000000	000	1

The touch pad will then return the Register Number =5 setting by sending Packet ID #2 to host.

Bit 16: Direct Key I/O Pressed State Configuration.

0: when button is pressed, Direct Key IO corresponding to button will output Low.

1: when button is pressed, Direct Key IO corresponding to button will output High.

Bit 15~Bit 8: Power Saving Time. This setting is user for setting time length of eKT2101 in order to decide eKT2101 Power consumption. 1 Power Saving Time = 10ms. If Power Saving Time set to 0, that means eKT2101 execute on Free Run mode (No Idle mode). Power Saving Time default is 100 (100*10ms=1s).

Bit 7~Bit 4: Calibration Speed. The bigger the number set, the fast the calibration speed. The default is 4.

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	0101	00000000 00000000	000	1

If host wants to write the Register Number 5 of the touch pad, it should send Packet ID #5 with register number 0101. Then the touch pad will keep the value.



Bit 16: Direct Key I/O Pressed State Configuration.

0: when button is pressed, Direct Key IO corresponding to button will output Low.

1: when button is pressed, Direct Key IO corresponding to button will output High.

Bit 15~Bit 8: Power Saving Time. This setting is user for setting time length of eKT2101 in order to decide eKT2101 Power consumption. 1 Power Saving Time = 10ms. If Power Saving Time set to 0, that means eKT2101 execute on Free Run mode (No Idle mode). Power Saving Time default is 100 (100*10ms=1s).

Bit 7~Bit 4: Calibration Speed. The bigger the number set, the fast the calibration speed. The default is 4.

11.2.7 Register Number = 6, TP Calibration Setting (Write Only)

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	0110	00000000 00000000	000	1

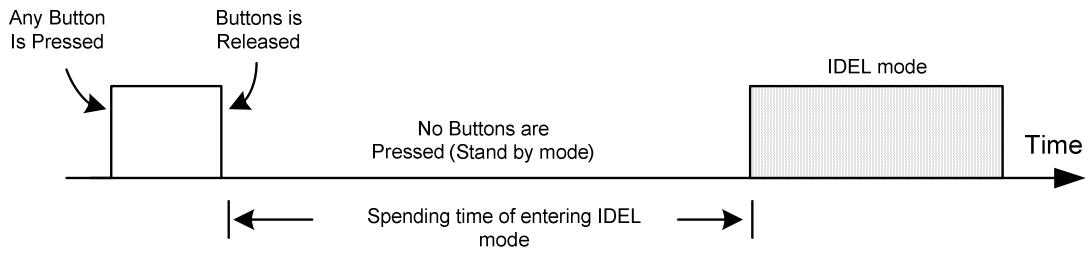
If the host wants to do Re_ Calibration to the touch pad, it should send Packet ID #4 with register number 0110. Then the touch pad will do calibration again.

Bit 19: Do Re-Calibration or not, 1 = Re-Calibration, 0 = Nothing

EX: If host want to do Re-Calibration, it should send the packet is 0B 01010100 01101000 00000000 00000001, then touch pad will do Re-Calibration. If touch pad calibration ok, the touch pad will send “calibration ok packet (A5 A5 A5 A5)” to let the host know that TP is calibration ok and ready for operation.

11.2.8 Register Number = 7, Entering IDLE time & I2C slave address setting (R/W)

When no TP buttons are pressed (Stand by), the bit15~bit8 of register provides setting of entering time length of idle mode.



When communication interface is I2C, this Bit7~Bit1 content of register provides I2C slave address setting. If this interface choose in SPI, Bit7~Bit1 will not provide any setting, and always keep 0.

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~3	3~1	0
0	101	0011	0111	00000000 00000000	000	1

If host wants to read the Enter to IDLE time of the touch pad, it should send Packet ID #3 with register number 0111.

	Type	PID	Register No.	Read Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	0111	00000000 00000000	000	1

The touch pad will then return the Register Number =7 setting by sending Packet ID #2 to host.

Bit 15~Bit 8: Entering IDLE time. This configuration content decides entering spending time of idle in Stand by (No buttons are pressed) mode. 1 Enter to IDLE Time = 50ms. If Enter IDLE Time set to 0, that means eKT2101 enter to IDLE mode immediately. Entering IDLE time default is 0 (0*50ms=0s).

Bit 7~Bit 1: I2C slave address. The default address is 0x10.

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	0111	00000000 00000000	000	1

If host wants to write the Register Number 7 of the touch pad, it should send Packet ID #5 with register number 0111. Then the touch pad will keep the value.

Bit 15~Bit 8: Entering IDLE time. This configuration content decides entering spending time of idle in Stand by (No buttons are pressed) mode. 1 Enter to IDLE Time = 50ms. If Enter IDLE Time set to 0, that means eKT2101 enter to IDLE mode immediately. Entering IDLE time default is 0 (0*50ms=0s).

Bit 7~Bit 1: I2C slave address. The default address is 0x10.



11.2.9 Register Number = 8, NA

11.2.10 Register Number = 9, NA

11.2.11 Register Number = 10, TP Touch Trigger Level (R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	1010	00000000 00000000	000	1

If host wants to read the “TP Touch Trigger Level” that add to finger’s threshold of touch pad, it should send Packet ID #3 with register number 1010.

	Type	PID	Register No.	Read Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	1010	00000000 00000000	000	1

The touch pad will then return the “TP Touch Trigger Level” that add to finger’s threshold of touch pad by sending Packet ID #2 to host.

Bit 16 ~ Bit 12: Button Select.

Button Select	Description
0~17	For setting the specific button Ex: 00000 -> Btn1
18~30	Revered
31	For setting all of the buttons, and not support reading

Bit 11 ~ Bit 4: finger on – constant. Default value is 48.

EX: If “TP Touch Trigger Level” of Button 12 = 10, the packet is 0B 01010010
10100000 11000000 10100001

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	1010	00000000 00000000	000	1

If the host wants to write “TP Touch Trigger Level” that add to finger’s threshold of touch pad, it should send Packet ID #4 with register number 1010. Then the touch pad will keep the value.



Bit 16 ~ Bit 12: Button Select

Button Select	Description
0~17	For setting the specific button Ex: 00000 -> Btn1
18~30	Revered
31	For setting all of the buttons, and not support reading

Bit 11 ~ Bit 4: TP Touch Trigger Level. Default value is 48.

EX: If host want to set the “TP Touch Trigger Level” of Button 10 = 20, the packet is 0B
01010100 10100000 10100001 01000001

11.2.12 Register Number = 11, NA

11.2.13 Register Number = 12, NA

11.2.14 Register Number = 13, NA

11.2.15 Register Number = 14, NA

11.2.16 Register Number = 15, NA



11.3 Enhance Command Description

The following is providing eKT2101 enhance command, Enhance command is different from the previous the description of command.

11.3.1 Packet ID #7 (Device to Host)

	Type	PID	Register No.	Read Register Response Data	
31	30~28	27~24	23~21	20~1	0
0	101	0111	-	-	1

The Touch pad will send this packet in response to Packet ID #7. The response data is determined by the register number in Packet ID # 7.

11.3.2 Packet ID #8 (Host to Device)

	Type	PID	Register No.	Reserve	
31	30~28	27~24	23~21	20~1	0
0	101	1000	-	-	1

This is a read command packet. The Host can read the information in different register number. Refer to enhance register number description.

11.3.3 Packet ID #9 (Host to Device)

	Type	PID	Register No.	Register Data	
31	30~28	27~24	23~21	20~1	0
0	101	1001	-	-	1

This is a write command packet. Host can change Register No. to write specified function. Refer to enhance register number description.

11.4 Enhance Register Description

The eKT2101 total provides 8 enhance Register. Enhance Register need to be used for Packet ID # 7, Packet ID # 8 and Packet ID # 9 to proceed the register of writing/reading.

**11.4.1 Enhance Register Number = 0, Bounce Count (R/W)**

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~21	20~1	3~1	0
0	101	1000	000	0 00000000 00000000	000	1

If host wants to read the “Bounce Count” that verify count of touch pad, it should send Packet ID #8 with enhance register number 000.

	Type	PID	Register No.	Read Register Data	Reserve	
31	30~28	27~24	23~21	20~4	3~1	0
0	101	0111	000	0 00000000 00000000	000	1

The touch pad will then return the “Bounce Count” that verify count of touch pad by sending Packet ID #7 to host.

Bit 15~12 (Bounce Count): When Finger touch on touchpad, Button Count must be equal to Bounce Count that Button can be admitted. The default value of Bounce Count is 2.

Bit 11~8: need to set 1010.

	Type	PID	Register No.	Writer Register Data	Reserve	
31	30~28	27~24	23~21	20~4	3~1	0
0	101	1001	000	0 00000000 00000000	000	1

If the host wants to write “Bounce Count” that verify count of touch pad, it should send Packet ID #9 with enhance register number 000. Then the touch pad will keep the value.

Bit 15~12 (Bounce Count): When Finger touch on touchpad, Button Count must be equal to Bounce Count that the Button can be admitted. The default value of Bounce Count is 2.

Bit 11~8: need to set 1010.

11.4.2 Enhance Register Number = 1, NA**11.4.3 Enhance Register Number = 2, NA**

**11.4.4 Enhance Register Number = 3, NA****11.4.5 Enhance Register Number = 4, TP Noise Level (R/W)**

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~21	20~1	3~1	0
0	101	1000	100	0 00000000 00000000	000	1

If host wants to read the “TP Noise Level” of touch pad, it should send Packet ID #8 with enhance register number 100.

	Type	PID	Register No.	Read Register Data	Reserve	
31	30~28	27~24	23~21	20~4	3~1	0
0	101	0111	100	0 00000000 00000000	000	1

The touch pad will then return the “TP Noise Level” of touch pad by sending Packet ID #7 to host.

Bit 20 ~ Bit 16: This field must set to 11111 to provide the entire Button setting

Button Select	Description
0~17	For setting the specific button Ex: 00000 -> Btn1
18~30	Revered
31	For setting all of the buttons, and not support reading

Bit 15 ~ Bit 8: Read TP Noise Level Data. Default value is 0x3C.

	Type	PID	Register No.	Writer Register Data	Reserve	
31	30~28	27~24	23~21	20~4	3~1	0
0	101	1001	100	0 00000000 00000000	000	1

If the host wants to write “TP Noise Level” of touch pad, it should send Packet ID #9 with enhance register number 100. Then the touch pad will keep the value.

Bit 20 ~ Bit 16: This field must set to 11111 to provide the entire Button setting

Button Select	Description
0~17	For setting the specific button Ex: 00000 -> Btn1
18~30	Revered
31	For setting all of the buttons, and not support reading



Bit 15 ~ Bit 8: Read TP Noise Level Data. Default value is 0x3C.

11.4.6 Enhance Register Number = 5, NA

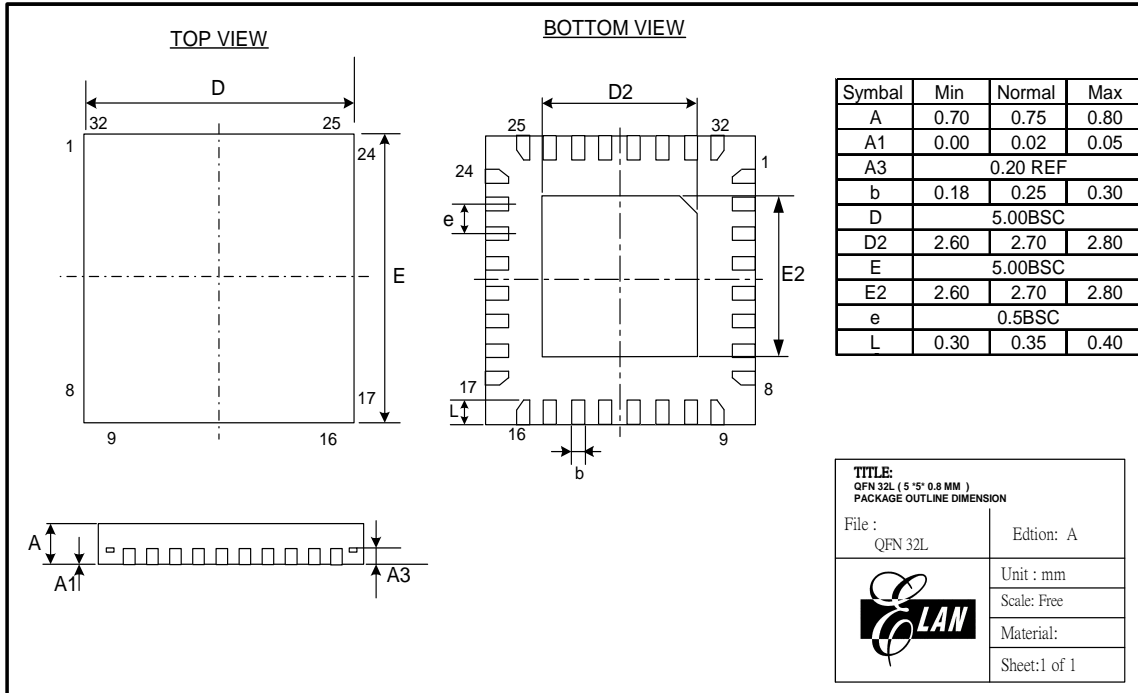
11.4.7 Enhance Register Number = 6, NA

11.4.8 Enhance Register Number = 7, NA

APPENDIX

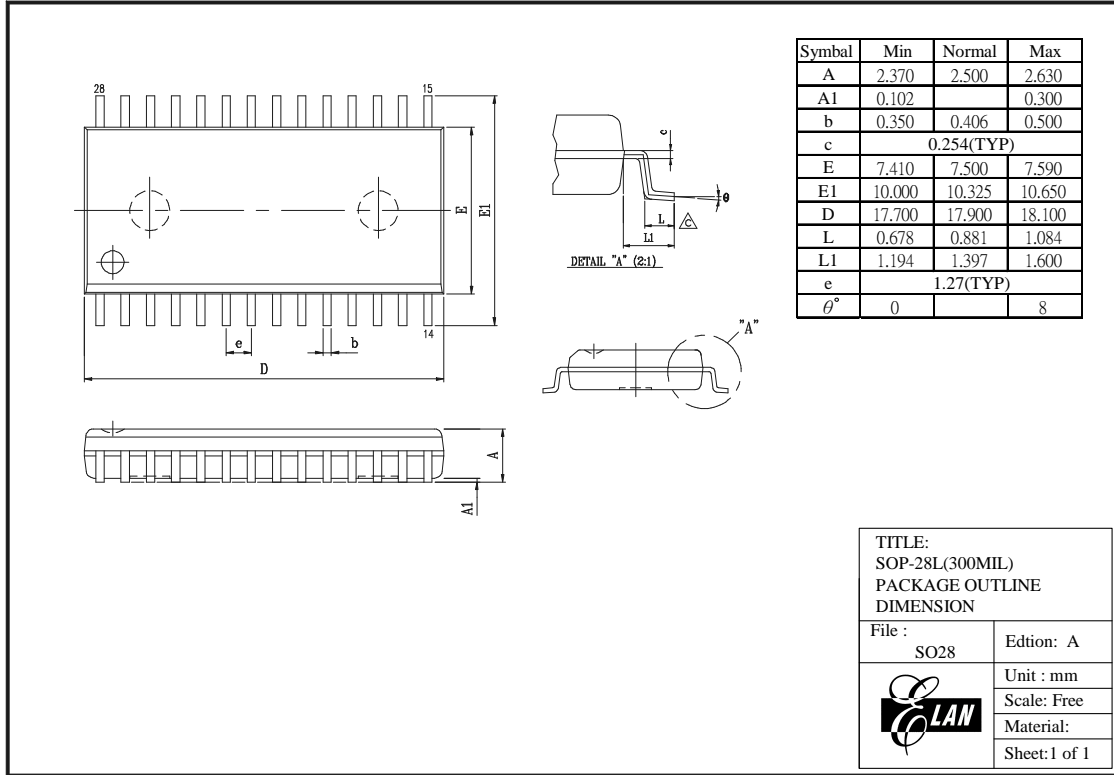
A Package Information

A.1 eKT2101QN32J

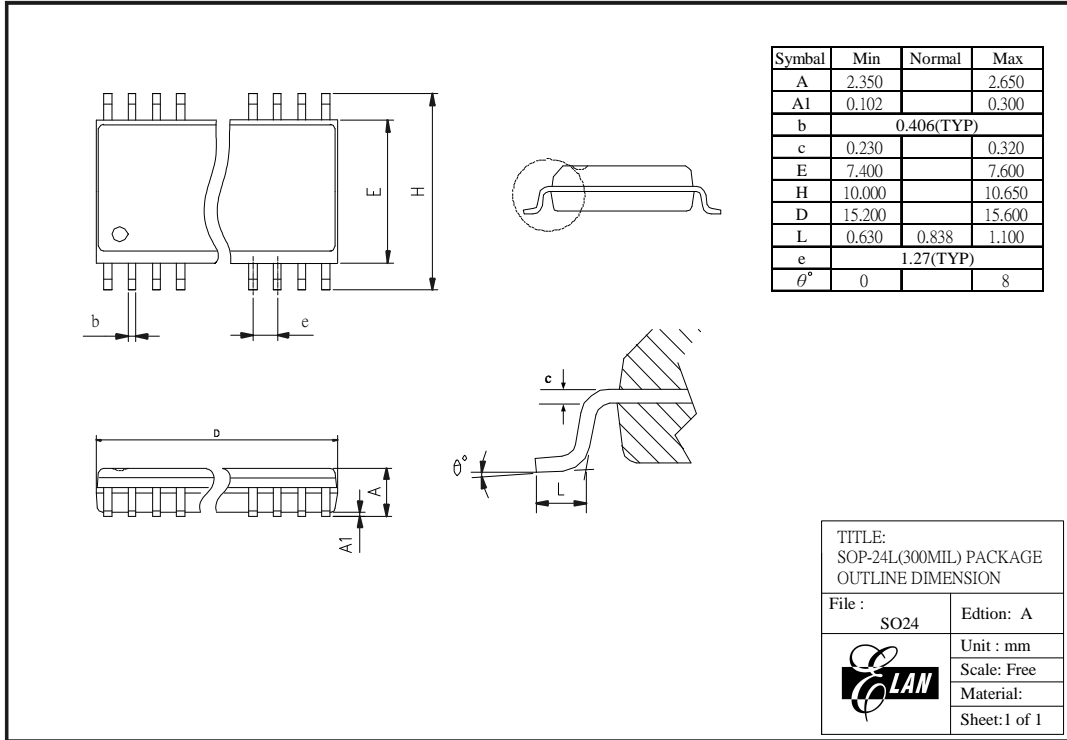




A.2 eKT2101SO28J

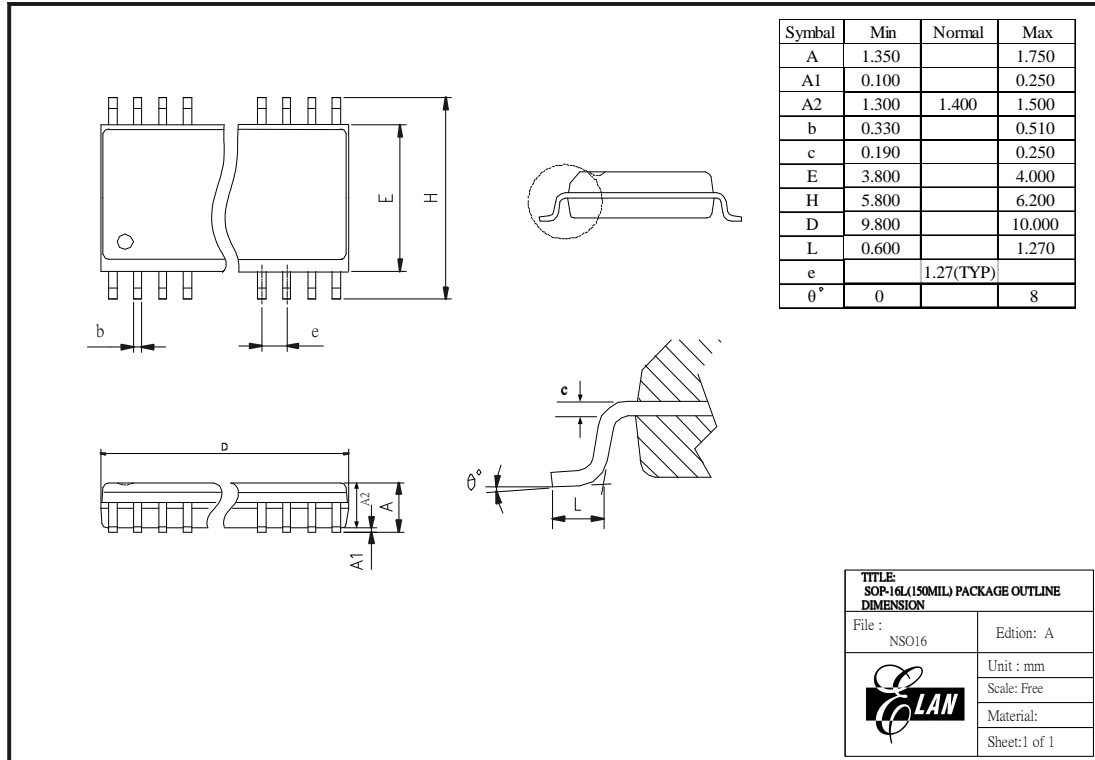


A.3 eKT2101SO24J





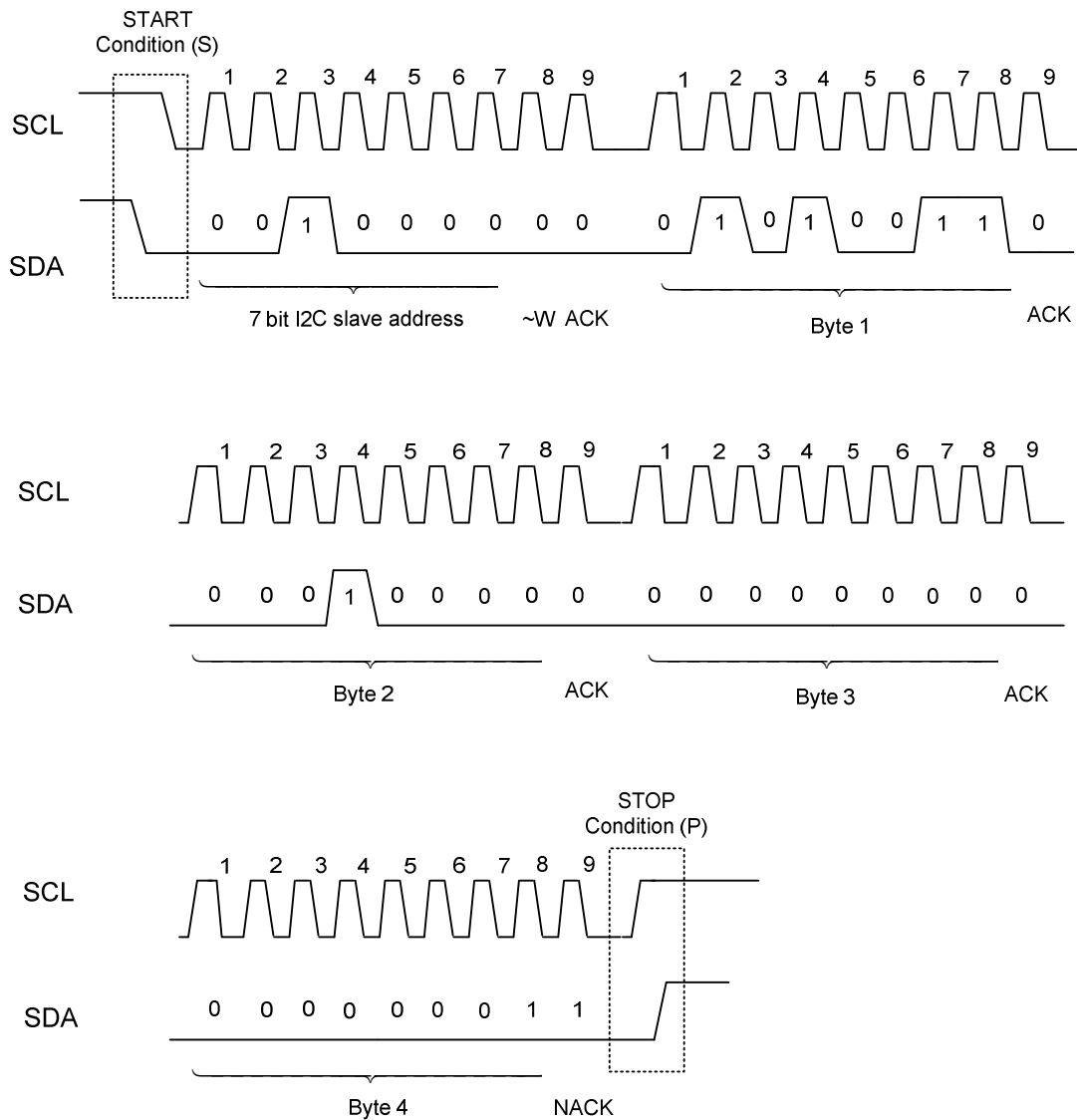
A.4 eKT2101SO16AJ



B The Example of I2C Interface Timing

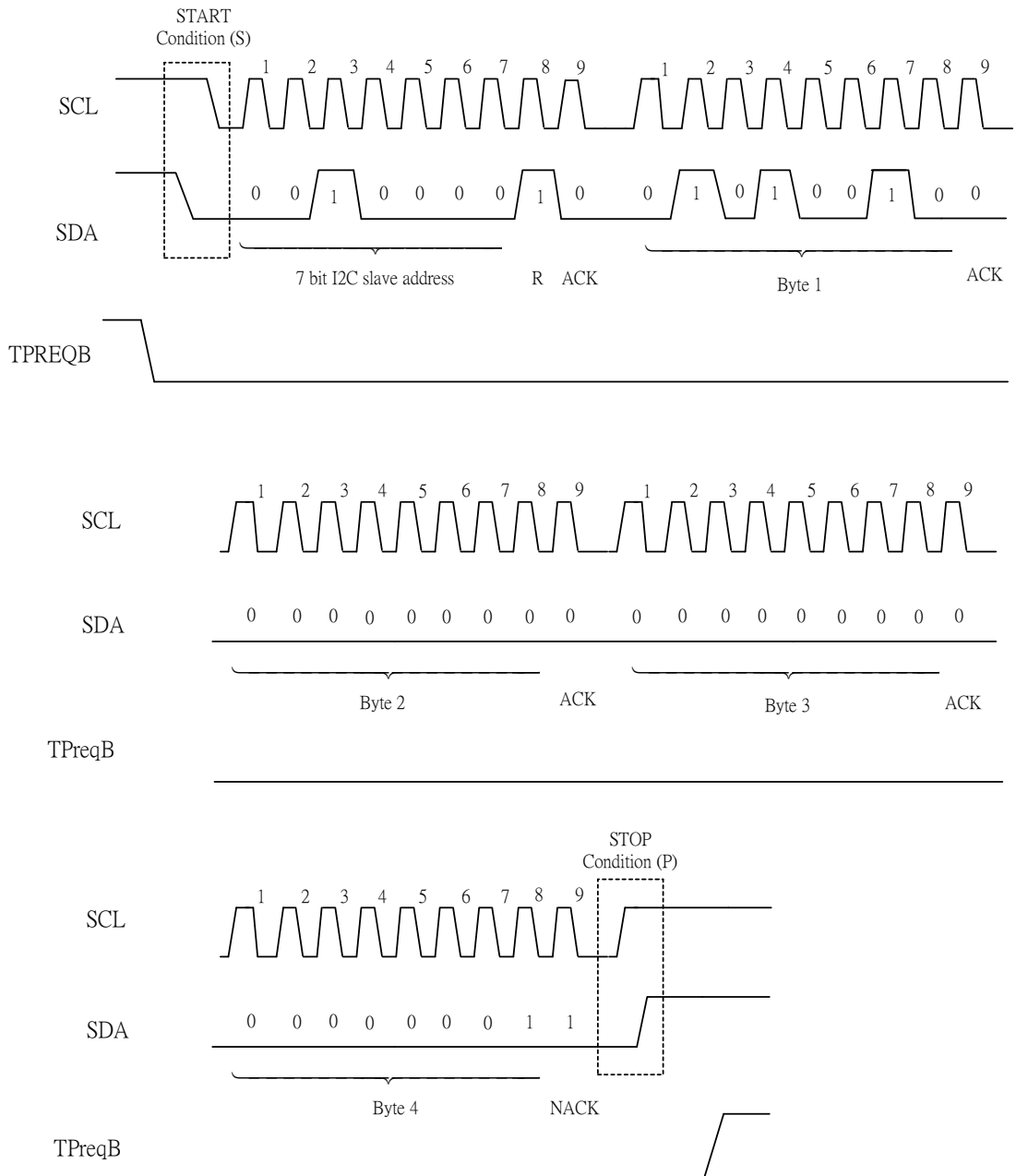
In this section of appendix, it will show more detail writing/ reading interface timing of I2C interface.

When Host use I2C interface (I2C slave address 0x10) to proceed to writing/ reading the content of register number = 1 (Read Button Status) in touchpad controller. Host need to write reading command (Packet ID #3) to touchpad controller. The command is 0B 01010011 0001000 00000000 00000001. Only TPregB maintains High status, HOST is able to transmit command to touchpad. The following is complete command timing:





After touchpad controller received Host command, touchpad controller will reply Button status to Host. If no any button is touched, the reply command of touchpad controller is 0B 01010010 0001000 00000000 00000001. When touchpad controller is ready to reply command, TPreqB will pull low informs Host to transmit data until Host receiving finished. After that, TPREQB will resend to High. The complete timing shows as follows:





C IOMODE USE I2C

When system operate in IOMODE , User want to communicate with eKT2101. So, User need to change configuration pins which need to be forced to high/low. User can add voltage-dividing circuits to force pull high/low change pull low/high.

Note:

VIH is 0.7VDD

VIL is 0.3VDD

D Parameter Update

User can adjust eKT2101 parameter for different environment (PCB layout and overlay thickness, etc.). There are 8 times to support this function. Please refer to the document “eKT2101 Parameter Multi-Write User Manual” to use.



E Approved Code Form of eKT2101

The Following Items are Filled-in by Customer

1. Part Number : _____ , Quantity : _____
Part Number : _____ , Quantity : _____

2. Contact details
Company name : _____
First name : _____ Last name : _____
Job Title : _____
eMail : _____
Address : _____
Phone : _____ Fax : _____

3. Shipping details (if different from above)
Company name : _____
First name : _____ Last name : _____
Job Title : _____
eMail : _____
Address : _____
Phone : _____ Fax : _____

4. Shipper A/C number : _____

5. Delivery Schedule: Date _____

Signature Customer: _____ Date: _____ Tel : _____

ELAN Sales: _____ Date: _____

ELAN FAE : _____ Date: _____